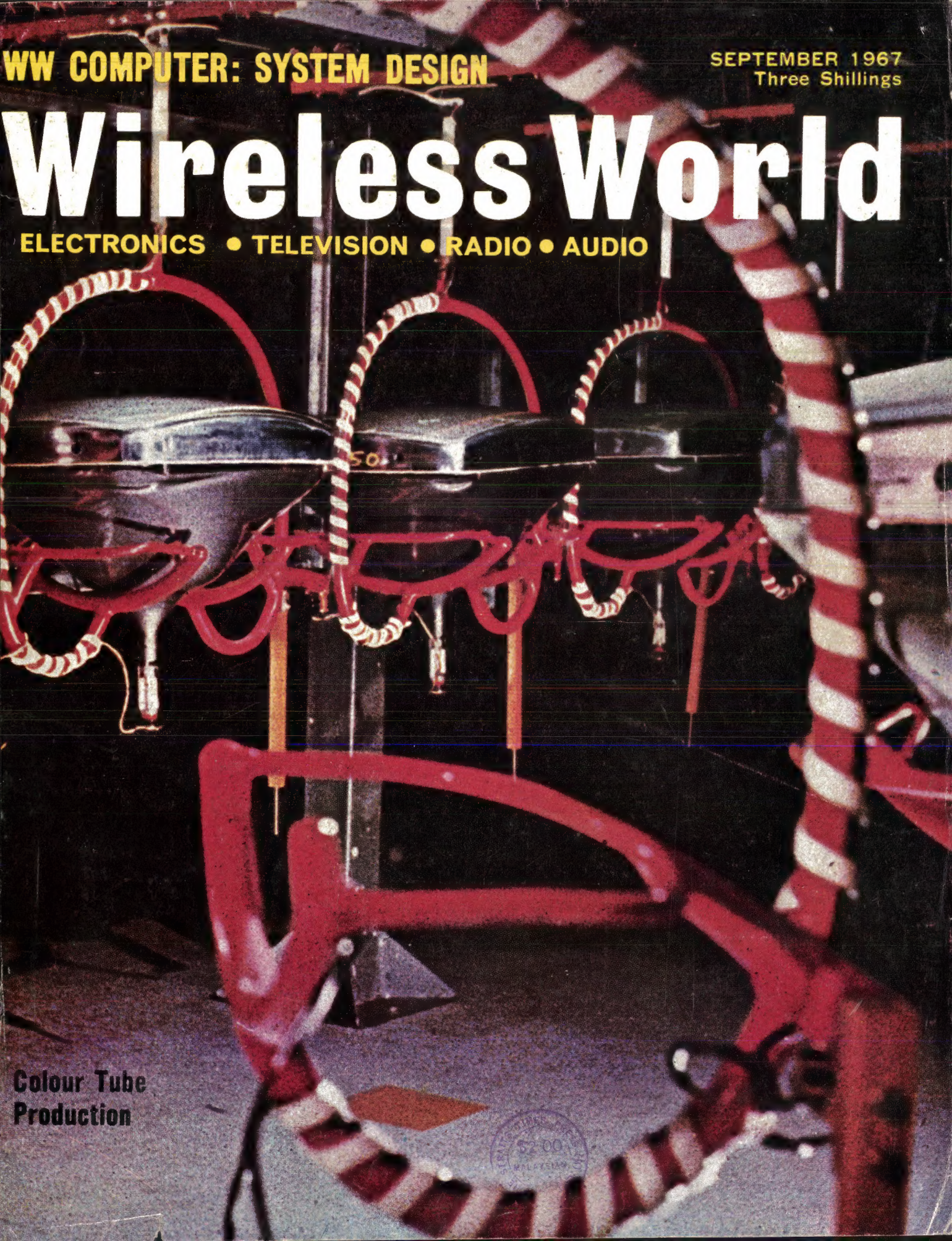
WW COMPUTER: SYSTEM DESIGN

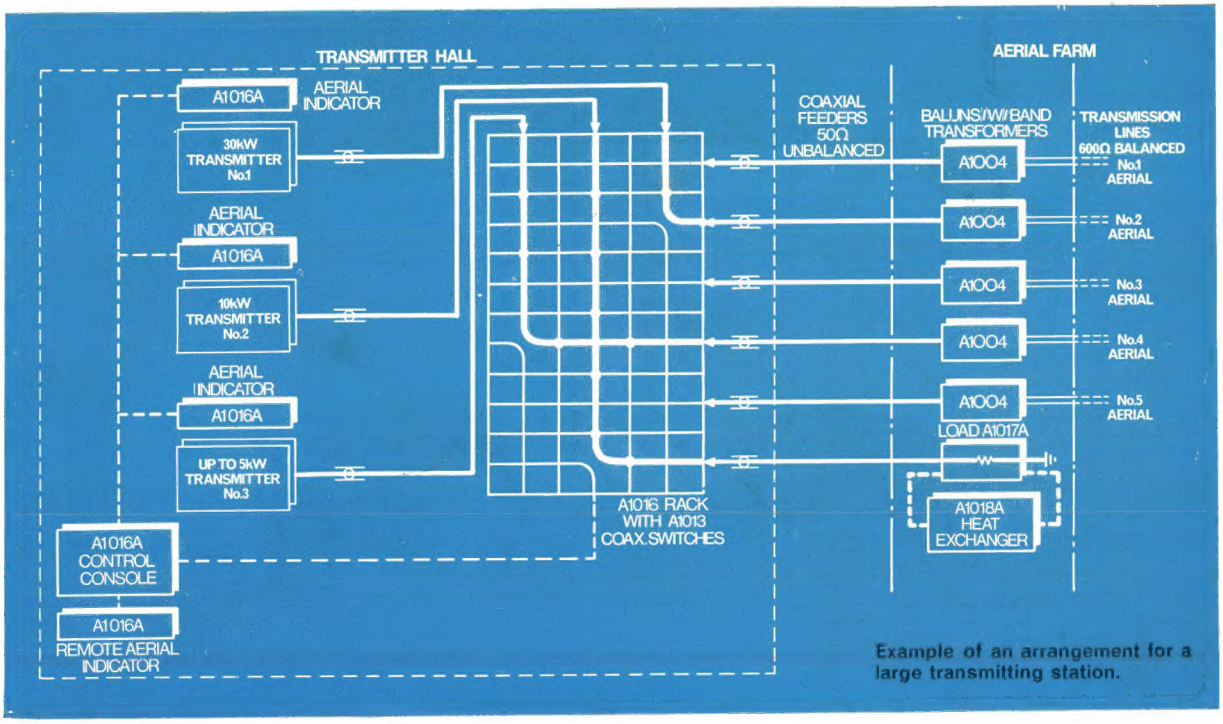
SEPTEMBER 1967
Three Shillings

Wireless World

ELECTRONICS • TELEVISION • RADIO • AUDIO



Colour Tube Production



Example of an arrangement for a large transmitting station.

Aerial ancillaries for STANFAST* transmitter systems

STANFAST automatic tuning and supervisory techniques enable the modern transmitting station to be operated with a minimum of attendance. The aerial systems for use with these stations must, of necessity, embody components designed specifically for this form of operation. STC can supply a complete range of aerial ancillaries for this purpose.

- 5kW and 10kW wideband aerial matching transformers A.1003 and A.1012
- 20/30kW baluns A.1004
- Co-axial crossbar switch A.1013
- 2 and 4-way co-axial switches A.1014-A and A.1015-A
- Crossbar aerial exchange A.1016-A comprising switching rack, crossbar switches, control console and lamp indicators.

STANFAST* The STC concept of automated radio stations.

**Registered Trade Mark.*

For further details, write, phone or telex Standard Telephones and Cables Limited, Radio Division, Oakleigh Road, New Southgate, London N.11. Telephone: ENTerprise 1234. Telex: 261912.

Coaxial Crossbar Switch Type A.1013B

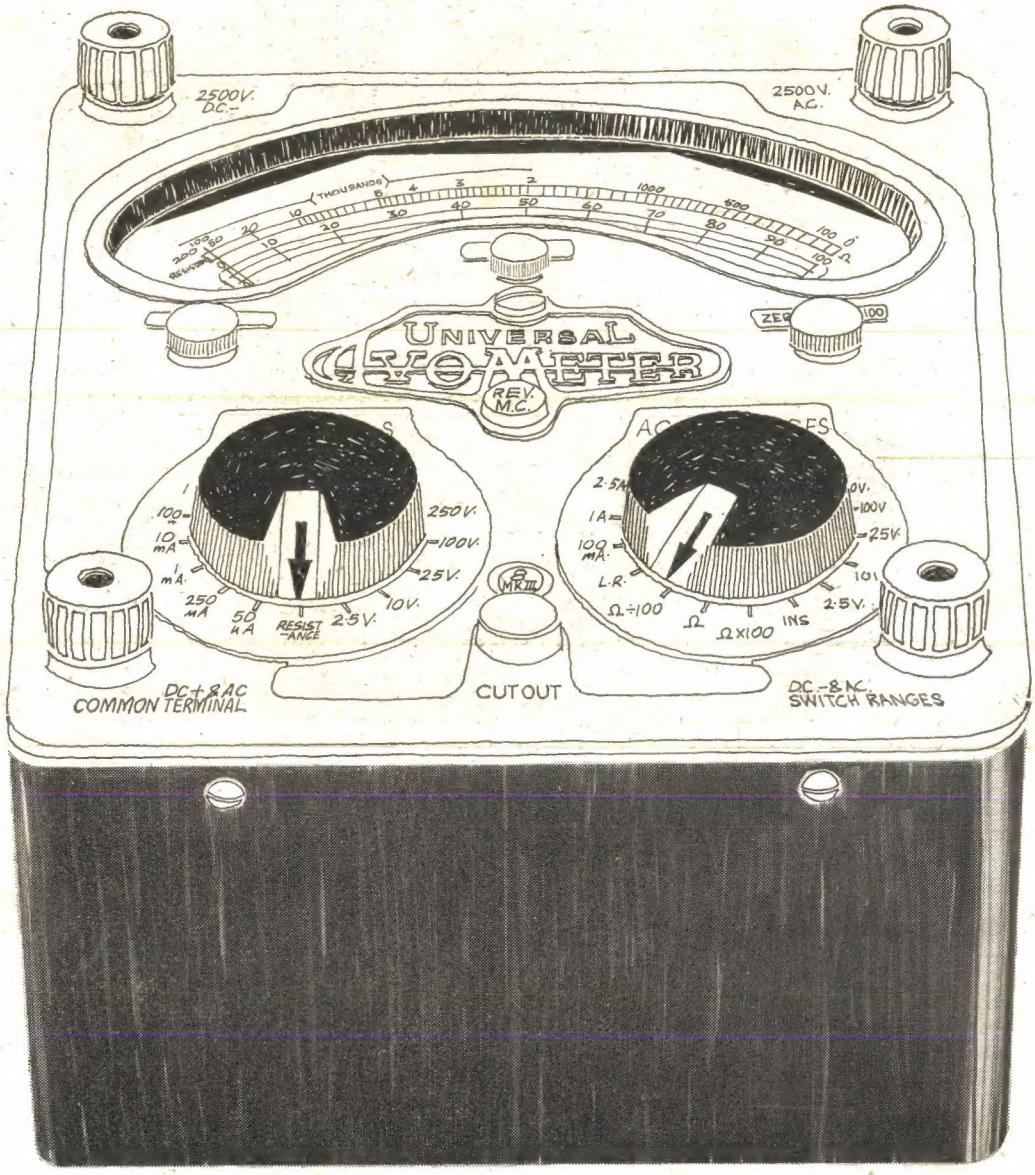
Wideband Matching Unit (Balun) Type A.1004

5kW Wideband Aerial Matching Transformer Type A.1003

world-wide telecommunications and electronics

STC

67/9E



OK, so you're a knob-twiddler

After all, you're only human, and those two big knobs on the Model 8 Avometer are terribly tempting. Just by twiddling them, you can have over 30 calibrated ranges at your command – 11 current, 15 voltage, 5 resistance, and a 30dB power scale. Twiddle yourself a good combination of accuracy (1%fsd/dcA, 2%fsd/dcV, 2½%fsd/ac) and sensitivity (20kΩ/Vdc, 1kΩ/Vac, except 2.5Vac scale 100Ω/V). Plus automatic cut-out, fused ohms circuit, trio of ohms zero-adjustments, reverse-polarity button and anti-parallax mirror. No wonder the Model 8 is the first choice of electronic, radio and TV engineers everywhere. Get yours from your local dealer or direct from Avo Ltd, Avocet House, Dover, Kent. Telephone Dover 2626. Telex 96283.

AVO

M GROUP

AVΩ MEANS BASIC MEASUREMENTS ALL OVER THE WORLD

A2

WW—003 FOR FURTHER DETAILS

A

Dial for a meter

Dial Euston 1639. Specify your meter . . . type, shape, size, F.S.D.
It's almost certainly on our premises right now. It will almost certainly be on yours tomorrow (G.P.O. and/or B.R. willing). If by chance we haven't got *precisely* what you want, we'll tell you when you can have it. Or which stock alternative, plus or minus a few ohms, will do the job. Or how long by our stopwatch it will take us to modify a stock meter for you. You'll always get a straight answer from Anders . . . and 99 times out of 100 the answer will delight you.

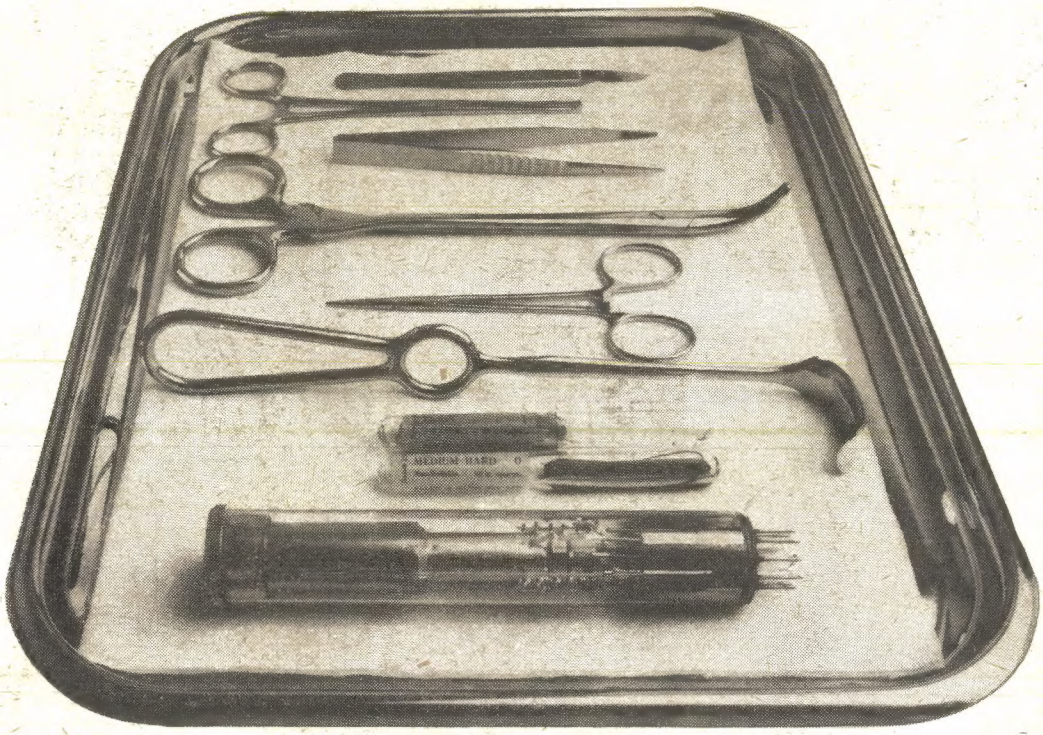
Manufacture and distribution of electrical measuring instruments and electronic equipment. The largest stocks in the U.K. for off-the-shelf delivery. Prompt supply of non-standard instruments and ancillaries. Sole U.K. distribution of FRAHM vibrating reed frequency meters and tachometers.

New comprehensive catalogue available free to manufacturers and bona-fide engineers.

ANDERS METER SERVICE

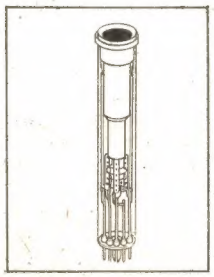
Anders Electronics Ltd · 103 Hampstead Road · London NW1 · Tel: Euston 1639
Ministry of Aviation Approved

WW—004 FOR FURTHER DETAILS



'Scalpel'
'Forceps'
'Ligatures'
'Camera'

Closed circuit television in hospitals offers students and observers intimate, first hand observation of surgery during an operation. But here, as with every other application, reliability and picture quality are all important. This is why EEV high sensitivity vidicons are so widely used. They offer remarkably good resolution, high sensitivity and short lag, besides being proved more reliable. EEV vidicons are available with two different values of heater current, 6.3V/600mA & 6.3V/95mA, and with either separate mesh or integral mesh construction. For further information and the name and address of your nearest stockist — Write to:



ENGLISH ELECTRIC VALVE COMPANY LIMITED

CHELMSFORD, ESSEX. TELEPHONE: 61777

AP294

WW—005 FOR FURTHER DETAILS

ANTIFERENCE CROSSHATCH AND DOT GENERATOR

Lowers the cost of every colour television receiver installation!

75 GNS

Approved and recommended by all leading T.V. manufacturers

also available
The Antiference
DEGAUSSING COIL
£6-10s

An extremely robust unit incorporating standard components for easy service and maintenance.

It is an undisputed fact that without means of checking colour convergence you are *just not in* Colour TV!! Another fact: the Antiference Crosshatch and Dot Generator is the most complete and inexpensive unit for colour convergence checking! It enables any TV field engineer to install colour TV without fuss, in the shortest possible time, and independent of a colour Test Card signal. Avoid colour TV installation problems from the start by using the Antiference Crosshatch and Dot Generator.

625 and 405 line generation
V.H.F. output channels 6 to 13
U.H.F. output channels 29 to 43
Crosshatch adjustable from 5 to 25 lines vertical and horizontal.

WEIGHT 9 lbs.
DIMENSIONS 12in. × 7in. × 5in.
POWER CONSUMPTION 30W (220/250v. A.C.)
Patents pending.

EVERY FIELD ENGINEER NEEDS ONE—ORDER YOURS NOW!

Available from all ANTIFERENCE Distributors—Made by Video Circuits, Barnet, Herts.

ANTIFERENCE LIMITED | AYLESBURY | BUCKS

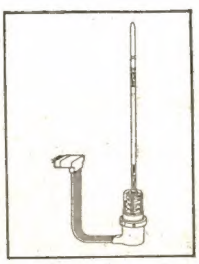
WW—006 FOR FURTHER DETAILS

Photograph by courtesy of Lenkurt Electric Co., Inc.

Where on earth can EEV TWTs work unattended?

Anywhere!

EEV Travelling Wave Tubes are often specified for use in out-of-the-way places such as microwave repeater stations, simply because they can be relied upon to operate for long periods in extremes of temperature without attention. The range of tubes offered by EEV for microwave, radar and other purposes includes both high and low power types and has recently been extended with two new types – the N1061, a broadband pulsed radar T.W.T. amplifier with peak outputs up to 1000kW, and the N1062, a continuous wave amplifier capable of an RF output of 3 to 5kW. Both offer the same long life advantages of other EEV T.W.T.s. For further information get in touch with:

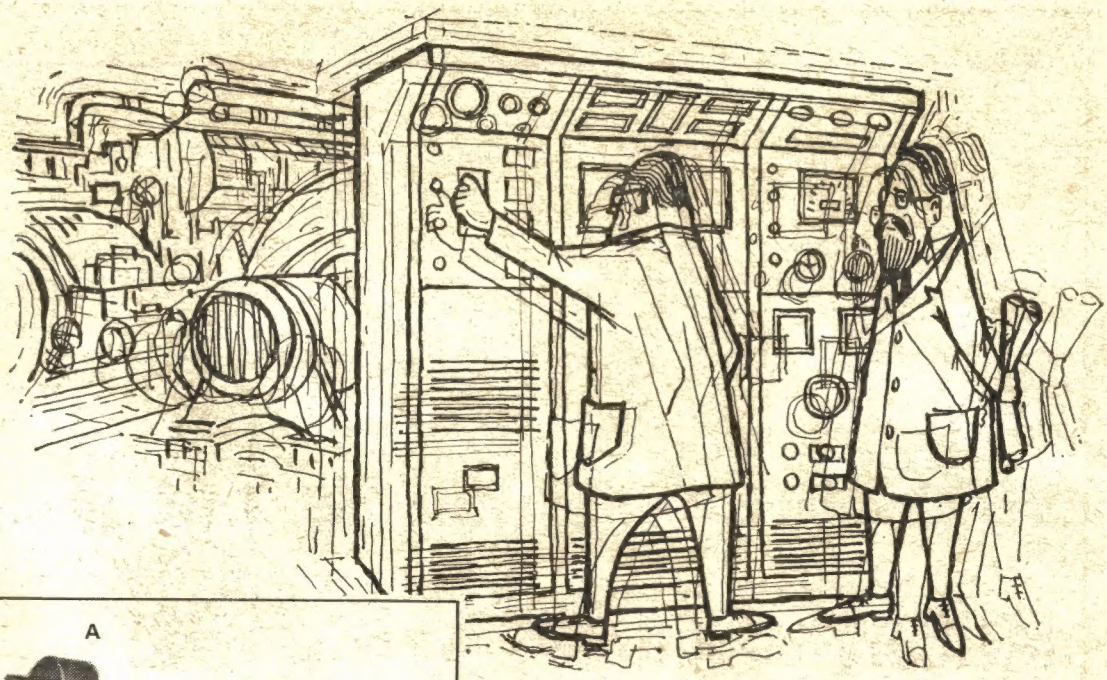


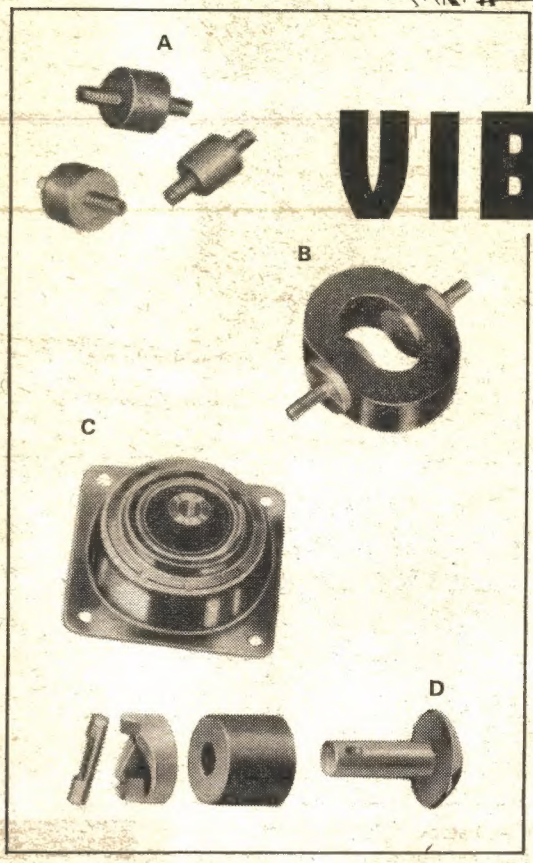
ENGLISH ELECTRIC VALVE COMPANY LIMITED

CHELMSFORD, ESSEX. TELEPHONE: 61777

AP-269

WW—007 FOR FURTHER DETAILS





VIBRATION?

The wide use of electronic equipment in industry, often in close proximity to machinery, presents new vibration problems. Every effort should be made to eliminate the trouble at its source by the use of Silentbloc machinery mountings, bearings and couplings; but local precautions in the electronic apparatus itself are also desirable, and there is an extensive Silentbloc range of devices for this purpose. A few are described here.

A. *Bonded rubber/metal stud mountings or supporting apparatus of light weight. There is a range of sizes of various degrees of stiffness.*

B. *Ring-type resilient mountings giving extra flexibility for shock insulation of sensitive equipment. Available in sizes to suit a great variety of applications.*

C. *Instrument mountings for general service offering good insulation with a useful degree of mechanical stability. Sizes and characteristics for every conceivable purpose.*

D. *"Vibrex" panel fasteners—quick one-hand action, with or without electrical and mechanical insulation between panel and base. Easier to fit than any other panel fastener: simple drilling of panel and base; no screwing, tapping, sweating or brazing.*

MOUNTINGS • BEARINGS • "VIBREX" PANEL FASTENERS

ANTI-VIBRATION DEVICES BY

SILENTBLOC

Andre Rubber Co. Ltd. is another Silentbloc Company

SILENTBLOC LTD • MANOR ROYAL • CRAWLEY • SUSSEX

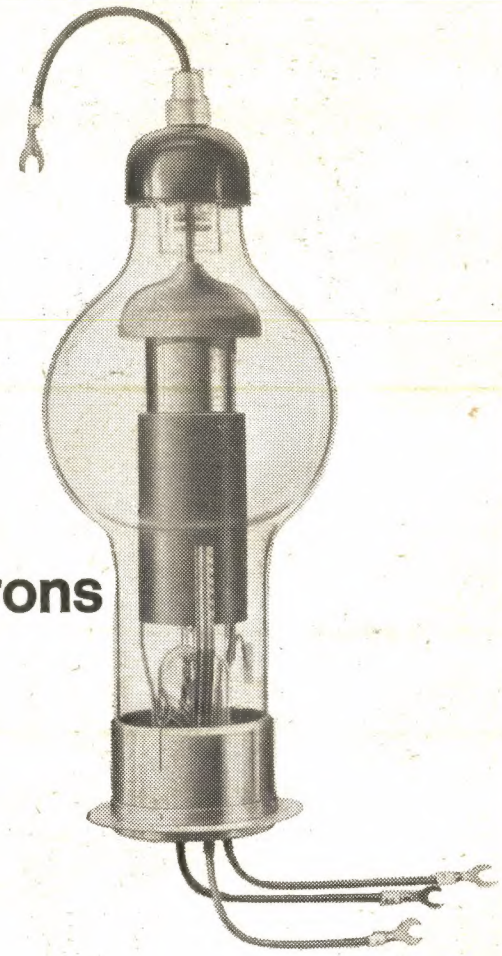
Telephone: Crawley 27733 Telegrams: Silentbloc Crawley

Silentbloc products are also manufactured by Silentbloc (Australia) Pty. Ltd., Melbourne

Broadway/S304

WW—008 FOR FURTHER DETAILS

Mercury Vapour Thyratrons



DATA

Type	Service type	Peak inverse voltage max. (kV)	Peak forward voltage max. (kV)	Peak anode current max. (A)	Mean anode current max. (A)
BT5	CV1147	1.5	1.0	12.5	2.5
BT17	—	1.5	1.0	40.0	6.0
BT19	CV1144	2.5	2.5	2.0	0.5
BT29	—	2.0	2.0	75.0	12.5
BT69	—	15.0	15.0	75.0	12.5
BT95	CV5141	15.0	15.0	12.0	1.5

This range of Mercury Vapour Thyratrons is available from your local EEV stockist. English Electric Valves production methods ensure the reliability and performance you are looking for and prices are competitive.

U.K. STOCKISTS FOR EEV PRODUCTS

SCOTLAND
Harper Robertson Electronics Ltd,
97 St. George's Road, Glasgow C3
Tel: Douglas 2711

N.W. ENGLAND: Anglesey, Caernarvonshire, Cheshire Cumberland, Denbighshire, Flintshire, Lancashire, Merionethshire, Montgomeryshire, Westmorland.

Downes & Davies Ltd,
G.P.O. Box 555, 72 Chapeltown Street,
Manchester 1. Tel: Ardwick 5292

Smith & Cookson Ltd, 49/57 Bridgewater Street,
Liverpool 1. Tel: Royal 3154/7

N.E. ENGLAND: Derbyshire, Durham, Lincolnshire, Northumberland, Nottinghamshire, Yorkshire

The Needham Engineering Co. Ltd,
P.O. Box 23, Townhead Street, Sheffield 1
Tel: Sheffield 27161

MIDLANDS: Cambridgeshire, Huntingdonshire, Leicestershire, Norfolk, Northamptonshire, Rutland, Shropshire, Staffordshire, Warwickshire, Worcestershire.

Coventry Factors Ltd, Coronet House,
Upper Well Street, Coventry. Tel: Coventry 21051

Gothic Electrical Supplies Ltd,
Gothic House, Henrietta Street, Birmingham 19
Tel: Birmingham Central 5060

LONDON, HOME COUNTIES & S.E. ENGLAND: Bedfordshire, Berkshire Buckinghamshire, Essex, Hampshire, Hertfordshire, Kent, Middlesex, Oxfordshire, Surrey, Sussex.

Edmundson Electronics Ltd,
60/74 Market Parade, Rye Lane, Peckham SE15
Tel: New Cross 9731

S.W. ENGLAND AND WALES: Brecknock, Cardiganshire, Carmarthenshire, Cornwall, Devonshire, Dorset, Glamorgan, Gloucestershire, Herefordshire, Monmouthshire, Pembrokeshire, Wiltshire.

Wireless Electric Ltd,
Wirelect House, St. Thomas Street, Bristol 1
Tel: Bristol 294313

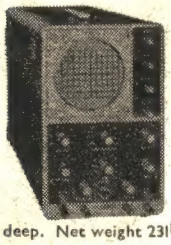
ENGLISH ELECTRIC VALVE COMPANY LIMITED CARHOLME ROAD, LINCOLN. TELEPHONE: 26352

WW—009 FOR FURTHER DETAILS

Heathkit DAYSTROM

Save Money! Build your own INSTRUMENTS · HI-FI · RADIO · Electronic kits

The construction manual provided with the kit ensures successful assembly.



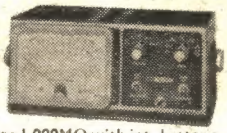
5in. GENERAL PURPOSE OSCILLOSCOPE Model 10-12U

An outstanding oscilloscope

● "Y" sensitivity 10 mV. r.m.s. per cm. at 1 kc/s. ● Bandwidth 3 c/s-4.5 Mc/s. ● Frequency compensated input attenuator X1, X10, X100. ● T/B 10 c/s-500 kc/s. in 5 steps. ● Two extra switch selected pre-set sweep frequencies in T/B. range. ● T/B output approx. 10 v. peak to peak ● Built-in 1V calibrator ● Facility for "Z" axis modulation ● Electronically stabilised power supply ● Power req. 100-250 v. A.C., 40-60 c/s., 89 watts ● Fused ● Front panel, silver and charcoal grey ● Cabinet, charcoal grey, size 8⅜×14×17in. deep. Net weight 23lb. 56-page construction and operation manual.

Kit.....**£35.17.6** Assembled **£45.15.0.**

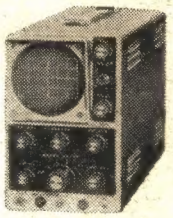
De Luxe 6in. VALVE VOLTMETER Model IM-13U



● Modern styling ● Extra features ● The ideal VVM for the Electronic Engineer ● 6in. Ernest Turner 200μA. meter with multi-coloured scales ● Unique gimbal bracket allows bench, shelf or wall mounting ● Measures A.C. (r.m.s.), D.C. volts 0-1.5, 5, 15, 50, 150, 500, 1,500 ● Resistance range 0.1 to 1,000MΩ with int. battery ● Vernier action zero and ohms adjustment ● Roller-tinned printed circuit ● High input resistance (11MΩ) ● Comprehensive assembly and operation manual ● Size 5×12½×4¾in. Complete with test prod and leads.

Kit.....**£18.18.0** Assembled **£26.18.0**

3in. PORTABLE SERVICE OSCILLOSCOPE Model OS-2



● Modern styling, lightweight and compact size, make this the ideal 'scope for service man, laboratory technician, amateur radio enthusiast or hobbyist ● "Y" bandwidth 2 c/s-3 Mc/s±3 dB. ● Sensitivity 100 mV/cm ● TB 20 c/s-200 kc/s. in four ranges ● Mu-metal c.r.t. screen ● Dimensions 5in. wide × 7⅞in. high ×12in. deep. Weight 9¾lb.

Kit.....**£23.18.0** Assembled **£31.18.0**

Outstanding value in a low-priced 'scope.

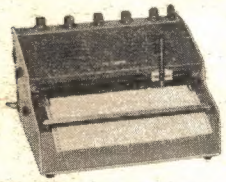
LOW-PRICED SIGNAL GENERATOR. Model RF-1U

● Provides extended frequency coverage on 6 bands on fundamentals and harmonics ● Ideal for the alignment and trouble shooting of RF, IF and audio circuits ● Large, easy-to-read dial ● Pre-aligned coil and bandswitch assembly RF output of at least 100 millivolts ● 100 kc/s-100 Mc/s. fundamentals up to 200 Mc/s harmonics ● 400 cycle audio signal with 4 v. output ● Dimensions 9½ in. wide × 6½in. high ×5in. deep.

Kit....**£13.18.0** Assembled **£20.8.0**

See the full range of Heathkit models in the free catalogue

Low-cost SERVO CHART RECORDER, EUW-20AE



● True potentiometric null-point balance on all ranges ● Provisions for plug-in modular accessories ● 10in. pen travel ● 0.1 sec.-per-in. response ● 5 ranges—10 to 250 mV ● Repeatability 0.2%—accuracy better than 1% ● Uses inexpensive cartridge type pen ● Rapid chart advance ● Factory assembled and tested.

EUW-20AE Assembled **£111.10.0**

For multispeed chart drive facility add unit EUA-20-26 ● 21 accurate speeds from 12in./minute to 0.5in./hour ● 5 rate scales. Assembled **£49.0.0**

The CAR RADIO you have asked for, Model CR-1

Complete your motoring pleasure with this small, compact, high output unit. Superb long and medium wave entertainment whenever you drive. For 12v. positive or 12v. negative car earth systems.

● 8 latest semi-conductors (6 transistors, 2 diode circuit) ● Powerful output (4 watts) will drive two speakers. Styled to harmonise with most car colour schemes ● Supplied in two units, pre-assembled and aligned RF unit kit. **£1.13.6** inc, P.T. IF/AF amplifier kit **£11.3.6.**

Total price kit (excl. LS)....**£12.17.0** inc. P.T.

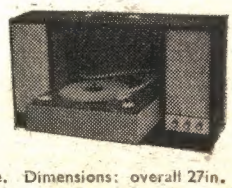
L/speakers and accessories available as extras.

Outstanding value in a D.C. supply! REGULATED POWER SUPPLY, Model IP-20U (Fully transistorised)

A good example of modern advanced design in instruments at a substantial saving in cost over comparable models. Its all-transistor circuitry will deliver up to 1.5 amps from 0.5 to 50 volts D.C.—with metered output voltage and current facility—adjustable current limiter protects both the supply and the circuit under test—overload relay protection against a short circuit or heavy overload. Modern styling, compact size. 9½×6½×11in. deep. A must for any laboratory.

Kit.....**£35.8.0** Assembled **£47.8.0**

New! Portable Stereo RECORD PLAYER, Model SRP-1



● Compact, economical stereo and mono record playing for the whole family ● Mains operated ● All "solid state" circuitry. Modern compact styling ● Detachable second loudspeaker gives optimum stereo effect ● Automatic playing of 16, 33, 45 and 78 rpm records ● Suitcase portability ● Two 8in.×5in. speakers ● Controls: Volume, Balance and Tone. Dimensions: overall 27in. wide×14¾in. high×7½in. deep.

Kit.....**£27.15.0**

● *Prices quoted above are Mail Order prices.* *Retail prices slightly higher* ● *Prices include free delivery in U.K.* ●

DAYSTROM LTD.

DEPT. W.W. 9, GLOUCESTER, ENGLAND

FREE BROCHURE AVAILABLE ON THE BRITISH INSTRUMENT RANGE OF MODELS

WW—010 FOR FURTHER DETAILS

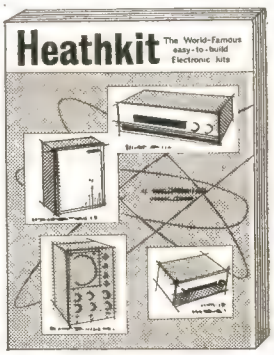
here are 3 good reasons why people enjoy building Heathkit electronics...

1 **The Creative Enjoyment and Unique Self-Satisfaction of "Do-It-Yourself."** People who build Heathkit electronics come from many different backgrounds . . . men in factories and offices; professional men from doctors to solicitors; housewives and career girls . . . even youngsters of all ages. The majority of them possess *no* special kit-building skills or electronic knowledge . . . just the ability to follow non-technical step-by-step instructions which even show how to solder.
These people also have something else in common. They enjoy the unique challenge kit-building offers . . . a chance to create a useful, sophisticated product from their own individual effort. A chance to enjoy a fascinating hobby that's different from the everyday routine. A chance to have enjoyment and relax . . . to forget daily problems in the peaceful pleasures of building a kit.
But the biggest thrill comes when they finish and turn it on. They experience that exhilarating sense of self-accomplishment. That feeling of personal victory when you've done something you doubted you could ever do.

2 **A Finished Product That Will Provide Years Of Superlative Performance.** Many years of accumulated kit engineering, the most experienced staff in the business, are brought to bear on design problems in all Heathkit product lines. And each product line has its own staff of engineering specialists, who devote their efforts to bringing you the latest techniques and advances in the "state of the art."
In addition, each new kit design must survive several stages of rigorous laboratory testing. And all kits are continually "field-tested" by people who are qualified to judge their performance. These tests are your assurance that every Heathkit is "*specification guaranteed*" . . . your assurance of long, dependable life that's as trouble-free as humanly possible.
But don't take our word for it. Compare the specifications. Read the reviews by respected electronics and hi-fi editors. Or ask any Heathkit owner . . . you'll find plenty of them around.

3 **Up to 50% Savings Over Factory-Built Versions.** Besides the fun of assembly and the high degree of quality, building your own Heathkit is economical. All kits represent considerable savings over comparable factory models . . . some selling for two or three times the Heathkit price. It's like getting paid for the hours you spend enjoying this latest space-age hobby.
The reasons for these significant savings are simple. First, you build it yourself, therefore the labour costs are eliminated. Second, you buy direct from the manufacturer, therefore no middleman profits are added to the price.
And yet, we offer more services than many dealers . . . liberal credit terms, advice on product selection, free technical consultation if you ever need it, and complete servicing facilities. You shop in the comfort of your home and get delivery right to your front door (and who doesn't get excited when a package arrives in the mail).
Heathkit offer Britain's largest selection of electronic kits . . . over 150 exciting, different kits . . . something for every interest . . . all described and illustrated in the FREE 36-page 1967 Heathkit Catalogue. Use the coupon below to send for your copy now . . . you'll enjoy it.

to get started, send for this Catalogue ...it's FREE!



36 pages packed with Britain's largest selection of electronic kits . . . over 150 in all . . . complete lines of stereo/Hi-Fi models, amateur radio gear, test and laboratory instruments, PA/Guitar amplifiers and educational kits. Includes helpful information on Hi-Fi in your home and planning a Hi-Fi system. Mail coupon or write DAYSTROM LTD., Dept. WW-9A, Gloucester for your personal FREE copy.

HEATHKIT

To DAYSTROM LTD. Dept. WW-9A
Gloucester, England. Tel: Glos 20217

☐ Please send me FREE British Heathkit Catalogue

☐ Further details of models

Name_____

Address_____

WW—011 FOR FURTHER DETAILS

Heathkit
DAYSTROM

WE ARE EXHIBITING | **ELECTRONICS, INSTRUMENTS, CONTROLS & COMPONENTS EXHIBITION at Belle Vue, Manchester Sept. 26th—29th 1967**

FM TUNER KIT, Model FM-4U

Tuning range 88-108 Mc/s Flywheel tuning. Atttractive perspex front panel in two tone grey with golden trim. Thermometer type tuning indicator, pre-aligned I.F. transformers. Own built-in power supply. Tuning heart model FMT-4U £2/15/- incl. P.T.

I.F. amplifier and power supply, Model FMA-4U. Complete with case and valves £13/13/-. Sold separately.

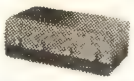
Kit Total £16.8.0

3+3 W HI-FI STEREO AMPLIFIER KIT Model S-33H

An inexpensive stereo-mono amplifier with the high sensitivity necessary for lightweight miniature ceramic pick-ups (e.g., Decca Deram). De luxe version of the S-33 with attractive two-tone grey Perspex panel.

Kit **£15.17.6** Assembled **£21.7.6**

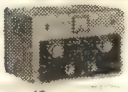
MONO CONTROL UNIT KIT Model UMC-1



Ideal for use with MA-12 or similar amplifier. Output 0.25 v. *Send for full details.*

Kit **£9.2.6** Assembled **£14.2.6**

AMATEUR TRANSMITTER KIT Model DX-40U



Covers all amateur bands from 80 to 10 metres, crystal controlled. Power input 75 watts C.W. 60 watts peak controlled carrier phone. Output 40 watts to aerial. Provision for VFO. Filters minimise T.V. interference. Modulator and power supplies are built-in. Single knob band switching is combined with a pi-network output circuit for complete operating convenience. A high-grade moving-coil meter indicates the final grid or anode current. Provision is made for the use of 3 crystals with access through a trap-door in the back of the cabinet. A 4-position switch selects the appropriate crystal or a jack for external VFO which can be used instead of the crystal(s). ***Prices now reduced to:—***

Kit .. **£29.19.0** Assembled **£41.8.0**

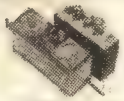
GENERAL COVERAGE RECEIVER KIT RG-1

An inexpensive communications type receiver specially designed for the short wave listener with many refinements found only in receivers costing much more. Freq. coverage 32 Mc/s.-1.7 Mc/s in 5 ranges also M.W. band.

Kit .. **£39.16.0** Assembled **£53.0.0**

Optional extras available.

GRIP-DIP METER KIT. Model GD-1U



Functions as oscillator or absorption wavemeter. With plug-in coils for continuous frequency coverage from 1.8 Mc/s. to 230 Mc/s.

Kit **£11.9.6** Assembled **£14.9.6**

Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. With dial correlation curves. **17/6.**

TRANSISTOR INTERCOM KITS Models XI-1U and XIR-1U

9 v. battery operated. Up to five remote stations can be operated with each Master. The Master unit can call any one, combination, or all five Remote stations and any Remote station can call the Master.

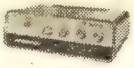
Model XI-1U (Master)

Kit .. **£11.9.6** Assembled **£17.9.6**

Model XIR-1U (Remote)

Kit .. **£4.9.6** Assembled **£5.18.0**

HI-FI STEREO AMPLIFIER KIT Model S-99



18 w. output (9 per channel with 0.2 per cent. distortion at 9 w. per channel). It has ganged controls. Stereo/Mono gram, radio and tape recorder inputs and push-button selection. Ultra-linear push-pull output. P.C. boards. Attractive Perspex front panel with golden surround and grey metal cabinet.

Kit **£28.9.6** Assembled **£38.9.6**

HI-FI SPEAKER SYSTEM KIT Model SSU-1

Ducted-port bass reflex cabinet "in the white." Frequency response is 40-16,000 c/s. Power rating 10 watts. Matched speaker units 8in. high flux (12,000 lines) with hyperbolic cone and 4in. wide angle dispersion type for higher frequencies.

Kit (with legs) **£12.12.0** (less legs) **£11.17.6** (inc. P.T.)

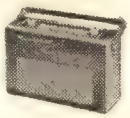
A.M./F.M. TUNER KIT

Tuning range 88-108 M. (FM) 16-50, 200-550, 900-2,000 m. Flywheel tuning. Attractive Perspex front panel in two-tone grey with golden trim. Thermometer type tuning indicator, pre-aligned I.F. transformers. Switched wide and narrow A.M. bandwidths.

TUNING HEART Model AFM-T1 £4/13/6 (inc. P.T.) **I.F. AMPLIFIER and Power Unit Model AFM-1.** Complete with metal cabinet and valves **£22/11/6.** Sold separately.

Kit Total **£27.5.0**

OXFORD TRANSISTOR PORTABLE RADIO KIT Model UXR-2



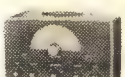
Beautiful leather case. Easy-to-read scale. 10 semi-conductors. Printed circuit board Special loudspeaker. Sockets for earphone tape recorder, car aerial, 9-volt battery operated. Easy to construct, excellent in performance and value.

Kit **£14.18.0** (incl. P.T.)

LOW-COST PORTABLE RADIO KIT, UXR-1 lw/mw Coverage. Leather case

Not illustrated. Kit **£12.11.0** (incl. P.T.)

SINE/SQUARE GENERATOR Model IG-82U



Covers 20 c/s-1 Mc/s. in 5 bands. Simultaneous Sine and Square Wave outputs. Less than 0.15μS rise time on Square Wave. Less than 0.5% distortion on Sine wave. Up to 10 volts output. This attractively styled generator is designed for maximum operating convenience. Size 13in. × 8½in. × 7in. deep.

Kit **£25.15.9** Assembled **£37.15.0**

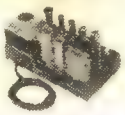
ELECTRONIC WORKSHOP KIT EW-1

20 exciting experiments can be made with this one kit.

Kit **£7.13.6** (incl. P.T.)

● Deferred Terms available on all orders above £10.

HI-FI MONO POWER AMPLIFIER KIT Model MA-12



A compact Hi-Fidelity power amplifier (including auxiliary power supply). 12 watts output. Wide frequency range and low distortion. A variable sensitivity control is fitted enabling it to be used with an existing amplifier in a stereophonic system. Other applications includes sound reinforcement systems, transmitter modulators, for use with tape recorders.

Kit **£12.18.0** Assembled **£16.18.0**

"COTSWOLD" SPEAKER SYSTEM KIT

This acoustically designed enclosure measures 26 × 23 × 14½in., and houses a special 12in. base speaker with 2in. speech coil, elliptical middle speaker, together with a pressure unit to cover the full frequency range of 30-20,000 c/s. Its polar-distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, cross-over unit, level control, grille cloth, etc. Left in the white for finish to personal taste.

Kit **£25.12.0** Assembled **£33.17.0**

Also available assembled and finished **£33.4.0**

4½in. VALVE VOLTMETER KIT Model V-7AU

The world's most popular valve voltmeter with printed circuit and 1 per cent. precision resistors to ensure consistent laboratory performance. It has 7 voltage ranges measuring respectively D.C. volts to 1,500 and A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance measurements from 0.1 ohm to 1,000 megohms, with internal battery. D.C. input resistance is 11 megohms and dB measurement has a centre-zero scale. Complete with test prod, leads and standardising battery. Power requirements, 200-250 v. 40-60 c/s. A.C. 10 watts.

H.V. and R.F. Probes available as optional extras.

Kit **£13.18.6** Assembled **£19.18.6**

DECADE RESISTANCE BOX KIT

Model DR-1U. Range 1-99,999Ω in 1Ω Steps. Ceramic switches throughout. Current rating from 500 mA. to 5 mA. according to decades in circuit. Polished wooden cabinet supplied complete.

Kit **£10.18.0** Assembled **£14.18.0**

● Prices include Postage U.K.

DECADE CAPACITOR KIT Model DC-1

Capacity values 100μμF to 0.11μF in 100μμF steps. Precision silver-mica capacitors and minimum loss ceramic wafer switches ensures high accuracy.

Kit **£7.15.0** Assembled **£10.18.0**

TELEVISION ALIGNMENT GENERATOR KIT Model HFW-1

Offers the maximum in performance, flexibility and utility at the lowest possible cost. Several outstanding features have been incorporated in this model which are unusual in instruments in this price range. Frequency coverage 3.6 Mc/s. to 220 Mc/s. on fundamentals. Unique non-mechanical sweep oscillator system. High level output on all ranges. Sweep deviations up to 42 Mc/s. Built-in fixed and variable marker generator (5 Mc/s. crystal supplied).

Kit **£38.18.0** Assembled **£49.15.0**

● Prices quoted are Mail Order Prices; retail prices slightly higher.

DAYSTROM LTD.

DEPT. W.W.9. GLOUCESTER, ENGLAND

Member of the Schlumberger Group including the Heath Company.

MANUFACTURERS OF THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

WW—012 FOR FURTHER DETAILS

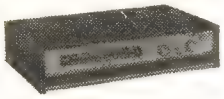
WE ARE EXHIBITING

INTERNATIONAL RADIO COMMUNICATIONS EXHIBITION, Royal Horticultural New Hall, London, SEPT. 27th—30th, 1967. STAND—18.

Heathkit DAYSTROM

***New! Transistorised* AM-FM Stereo/Mono TUNER**

Designed to operate with the de luxe transistor Amplifier AA-22U, or any similar amplifier.



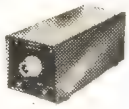
★ **18 transistor, 3 diode circuit**
★ **AM-LW/MW, FM stereo and FM mono tuning**
★ **Automatic stereo indicator light**

★ **Stereo phase control for max. separation, min. distortion.** ★ **Automatic frequency control for positive "Lock-in" tuning.** ★ **Automatic gain control for even, steady volume.** ★ **Pre-assembled and aligned "Front End."** ★ Separate AM and FM circuit boards. ★ Self-powered. ★ Low silhouette styling—matches AA-22U. ★ **Handsome Walnut veneered cabinet** (optional extra).

Available for your convenience in separate parts and can be supplied for a **TOTAL PRICE KIT £32.7.0** incl. P.T.
Optional extra: Walnut veneered cabinet **£2.5.0.**

Stereo FM DECODER, Model SD-1

A low cost transistorised unit



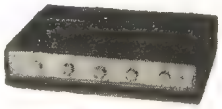
Specially designed for use with Heathkit tuners, models FM-4U and AFM-1, but, because it is self-powered, it may also be used with most other makes of FM tuner. **KIT £8.10.0** Assembled **£12.5.0.**

BERKELEY Slim-line SPEAKER SYSTEM

A new concept in Heathkit loudspeaker design. The cabinet shell is assembled and finished in superb Queensland walnut veneer. Two specially designed speakers, a 12in. bass unit and 4in. mid/high frequency unit and an L.C. cross-over network provide the smooth 30-17,000 c/s, frequency response. Its professional cabinet styling will blend with both traditional and contemporary decors. 15 ohm nominal impedance. Size 26in. × 17in. × 7¾in. deep.

KIT.....£19.10.0 Assembled.....**£24.**

The outstanding 20+20 WATT TRANSISTOR STEREO AMPLIFIER Model AA-22U



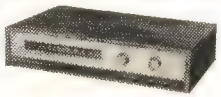
★ Professional, elegant, slim-line styling.
★ 5 stereo inputs (each channel).
★ 20 transistor, 10 diode circuit.
★ Superb performance for price.

Dimensions: 15 9/16in. w. × 3 7/8in. h. × 12⅛in. deep. Kit **£39.10.0** less cabinet. Assembled **£59.15.0** incl. cabinet.

Optional extra Walnut veneered cabinet **£2.5.0.**

COMPARE ANY HEATHKIT MODEL FOR PRICE, PERFORMANCE, QUALITY

***Enjoy the BBC stereo FM transmissions with the* New de Luxe TRANSISTOR STEREO FM TUNER (Model TFM-IS)**



Mono version TFM-IM also available.

Designed to harmonise and match the "International Class" de luxe transistor amplifier, AA-22U.

★ **Professional, elegant, slim-line styling**
★ **Tuning range 88-108 Mc/s.**
★ **14 Transistor, 4-diode circuit**
★ **Pre-assembled, pre-aligned RF Tuning heart**
★ **4 stage I.F. amplifier**
★ **Own built-in power supply**

Optional extra. Walnut veneered cabinet **£2.5.0**

Available for your convenience in separate parts and can be built for a
Total price kit Model TFM-IM (Mono) £20.19.0 incl. P.T.
Total price kit Model TFM-IS (Stereo) £24.18.0 incl. P.T.

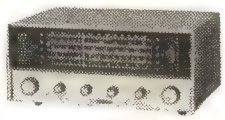
A Low-cost transistor stereo Amplifier 3 + 3 Watt output Model TS-23

Breaks the price barrier in transistor amplifier cost. Incorporates all the essential features for good quality reproduction from gram, radio and other sources.

★ **3 watts rms (15 ohms) per channel**
★ **Wide frequency response 15 c/s to 18 Kc/s —3 dB**
★ **New compact, professional slim-line styling**
★ **For free-standing or cabinet mounting**

Price Amplifier TS-23 (less Cab.) **KIT £17.15.0**
Amplifier and Cabinet KIT £18.19.0

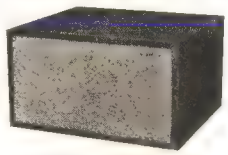
LOW-COST SHORTWAVE RECEIVER, GR-64E



● 4 bands—3 shortwave bands cover 1.5 Mc/s to 30 Mc/s, plus 550 kc/s to 1,620 kc/s AM broadcast band ● Built-in 5in. permanent magnet speaker for a big, bold sound ● Illuminated 7in. slide-rule dial with extra logging scale ● Easy to read lighted bandspread tuning dial for precise station selection ● Relative signal strength indicator aids pin-point station tuning ● 4-valve superhet circuit plus two silicon diode rectifiers ● Variable BFO control for code and SSB transmissions ● Built-in external antenna connections ● Built-in AM rod antenna ● Fast, simple circuit board construction assures stability ● Handsome 'low-boy' styling—charcoal grey cabinet, black front panel, and green and white band markings ● Headphone jack for private listening. Power requirements: 115, 230 v. 50-60 c/s A.C. 30 watts. Dimensions: 13½in. wide × 6in. high × 9in. deep.

KIT £19.19.0 Assembled **£24.19.0**

At last, good performance from a 'MINI' Speaker with the AVON compact speaker system.



Fully finished cabinet facilitates faster construction. This model offers substantial saving in price over models of a similar size and performance.

★ **Mini size—only 7¾in. w. × 13¼in. h. × 8¾in. deep**
★ **For use with amplifiers with 8-16Ω output impedance**
★ **Beautiful fully finished wooden cabinet**
★ **Two special loudspeakers, 6in. bass, 3in. HF unit**

In two separate parts, can be purchased for a total kit price of **£13.16.0,** incl. P.T. Send for full leaflet.

Mail TODAY for your FREE Copy of the Heathkit catalogue

Mail Order prices quoted incl. Post U.K. Retail prices 5% extra.

WELCOME TO OUR LONDON HEATHKIT CENTRE

233 Tottenham Court Rd., W.1.
Tel.: 01-636-7349
Opening times:
Mon.-Fri. 9 a.m.—5.30 p.m.
Sat. 9 a.m.—1 p.m.

To DAYSTROM LTD. Dept. WW9, Gloucester. Tel. Glo. 20217

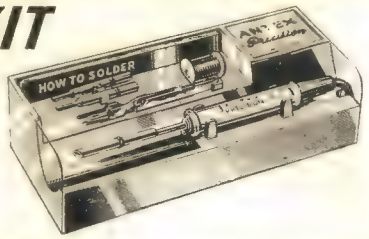
Please send me FREE CATALOGUE (Yes/No).....
Please send me model(s).....
For which I enclose £ s d post paid.
NAME.....
(Block Capitals)
ADDRESS .....
.....

Please send FREE copy of Catalogue to my friend.
NAME .....
ADDRESS .....
..... WW9

WW—013 FOR FURTHER DETAILS

—AN IRON FOR EVERY PRECISION NEED!

NEW—Complete Precision Soldering KIT



This kit—in a rigid plastic "tool-box" —contains everything you need for precision soldering.

- Model CN 15 watts miniature iron, fitted $\frac{3}{16}$" bit.
- Interchangeable spare bit, $\frac{5}{32}$"
- Interchangeable spare bit, $\frac{3}{32}$"
- Reel of resin-cored solder
- Felt cleaning pad
- Stand for soldering iron
- Space for stowage of lead and plug

PLUS **36-page booklet on "How-to-Solder" —a mine of information for amateur and professional.**

49/6d

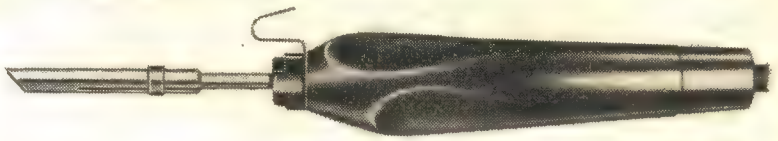
From Electrical and Radio Shops, or if unobtainable locally apply direct to ANTEX LTD.

ANTEX

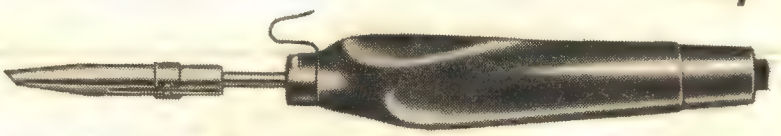
Grosvenor House,
Croydon, CR9 1QE
Telephone 01-686 2774

CN 15 watts. Ideal for miniature and micro miniature soldering. Interchangeable spare bits available from .040" (1 mm) up to $\frac{3}{16}$" For 240, 220, 110, 50 or 24 volts. **32/6**

G 18 watts. Ideal for miniature work on production lines. Interchangeable spare bits, $\frac{3}{32}$", $\frac{1}{8}$", $\frac{3}{16}$" and $\frac{1}{4}$". For 240, 220 or 110 volts. **32/6**



E 20 watts. Fitted with $\frac{1}{4}$" bit. Interchangeable spare bits $\frac{3}{32}$", $\frac{1}{8}$", $\frac{3}{16}$". For 240, 220, 110 or 24 volts. **35/-**



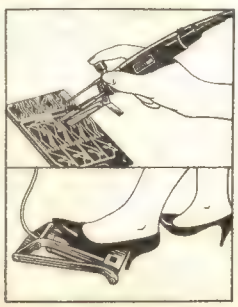
ES 25 watts. Fitted with $\frac{1}{8}$" bit. Interchangeable bits $\frac{3}{32}$", $\frac{3}{16}$" and $\frac{1}{4}$". Ideal for high speed production lines. For 240, 220, 110, 24 or 12 volts. **35/-**

F 40 watts. Fitted $\frac{5}{16}$" bit. Interchangeable bits $\frac{1}{4}$", $\frac{3}{16}$", $\frac{1}{8}$", $\frac{3}{32}$". Very high temperature iron. Available for 240, 220, 110, 24 or 20 volts. **42/6**

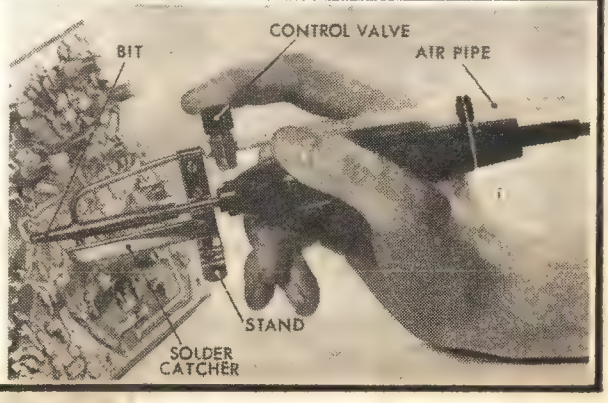
Spare bits and elements for all models and voltages immediately available from stock.

Send for the 16-page ANTEX main catalogue

THE ANTEX DE-SOLDERING TOOL



Soldered joints can now be easily, speedily and neatly unsoldered. A self-cleaning nozzle, exclusive to the ANTEX De-Soldering Irons, sucks up molten solder into stainless steel catcher. Operates by compressed air from airline or standard foot-pump. Type ESS (25W) for 240, 220, 110 or 24 volts. Type GSS (18W) for 240, 220 or 110 volts. Price **£4. 4. 0d.** De-Soldering Tool complete with foot-pump, as illustrated **£4 .19 . 6d.**



WW—014 FOR FURTHER DETAILS

VALUABLE NEW HANDBOOK FREE TO AMBITIOUS ENGINEERS

Have you had *your* copy of "Engineering Opportunities"?

The new edition of **"ENGINEERING OPPORTUNITIES"** is now available—without charge—to all who are anxious for a worthwhile post in Engineering. Frank, informative and completely up to date, the new **"ENGINEERING OPPORTUNITIES"** should be in the hands of every person engaged in any branch of the Engineering industry, irrespective of age, experience or training.

On 'SATISFACTION OR REFUND OF FEE' terms

This remarkable book gives details of examinations and courses in every branch of Engineering, Building, etc., outlines the openings available and describes our Special Appointments Department.

WHICH OF THESE IS YOUR PET SUBJECT?

ELECTRONIC ENG.
Advanced Electronic Eng. — Gen. Electronic Eng.—Applied Electronics — Practical Electronics — Radar Tech. — Frequency Modulation — Transistors.

RADIO ENG.
Advanced Radio — Gen. Radio — Radio & TV Servicing — TV Eng. — Telecommunications — Sound Recording — Automation — Practical Radio — Radio Amateurs' Exam.

ELECTRICAL ENG.
Advanced Electrical Eng. — Gen. Electrical Eng. — Installations — Draughtsmanship — Illuminating Eng. — Refrigeration — Elem. Electrical Science — Electrical Supply — Mining Electrical Eng.

MECHANICAL ENG.
Advanced Mechanical Eng.— Gen. Mechanical Eng. — Maintenance Eng. — Diesel Eng. — Press Tool Design — Sheet Metal Work—Welding — Eng. Pattern Making — Inspection — Draughtsmanship — Metallurgy — Production Eng.

CIVIL ENG.
Advanced Civil Eng. — Gen. Civil Eng.—Municipal Eng.— Structural Eng. — Sanitary Eng. — Road Eng. — Hydraulics — Mining — Water Supply — Petrol Tech.

AUTOMOBILE ENG.
Advanced Automobile Eng. — Gen. Automobile Eng. — Automobile Maintenance — Repair — Automobile Diesel Maintenance — Automobile Electrical Equipment — Garage Management.

WE HAVE A WIDE RANGE OF COURSES IN OTHER SUBJECTS INCLUDING CHEMICAL ENG., AERO ENG., MANAGEMENT, INSTRUMENT TECHNOLOGY, WORKS STUDY, MATHEMATICS, ETC.

Which qualification would increase your earning power?
A.M.I.E.R.E., A.M.I.Mech.E., A.M.S.E., A.M.I.C.E., B.Sc., A.M.I.P.E., A.M.I.M.I., A.R.I.B.A., A.I.O.B., A.M.I.Chem.E., A.R.I.C.S., M.R.S.H., A.M.I.E.D., A.M.I.Mun.E., C.ENG., CITY & GUILDS, GEN. CERT. OF EDUCATION, ETC.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

411A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE

THIS BOOK TELLS YOU

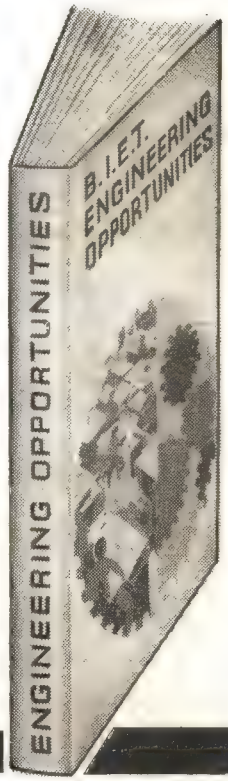
- ★ *HOW to get a better paid, more interesting job.*
- ★ *HOW to qualify for rapid promotion.*
- ★ *HOW to put some letters after your name and become a key man . . . quickly and easily.*
- ★ *HOW to benefit from our free Advisory and Appointments Depts.*
- ★ *HOW you can take advantage of the chances you are now missing.*
- ★ *HOW, irrespective of your age, education or experience, YOU can succeed in any branch of Engineering.*

132 PAGES OF EXPERT CAREER-GUIDANCE

PRACTICAL EQUIPMENT
Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, etc. A.M.I.E.R.E. City & Guilds Radio Amateurs' Exam., R.T.E.B. Certificate, P.M.G.Certificate, Practical Radio, Radio & Television Servicing, Practical Electronics, Electronics Engineering, Automation.

INCLUDING TOOLS
The specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T.



You are bound to benefit from reading **"ENGINEERING OPPORTUNITIES,"** Send for your copy *now*—FREE and without obligation.

POST NOW!

TO B.I.E.T. 446A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE.

3d. stamp if posted in an unsealed envelope.

Please send me a FREE copy of "ENGINEERING OPPORTUNITIES." I am interested in (state subject, exam., or career).

.....

NAME.....

ADDRESS .....

.....

.....

WRITE IF YOU PREFER NOT TO CUT THIS PAGE

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD

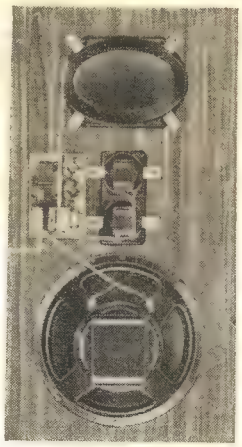
WW—015 FOR FURTHER DETAILS

Peerless

HI-FI BAFFLE SPEAKER SYSTEMS FOR MONO AND STEREO

The new Peerless systems are engineered to the high quality standards that have made Peerless pre-eminent in high-fidelity design over the past years. Our experience, together with the most careful selection of materials and strictest manufacturing controls, assure performance of highest quality.

All the speaker systems are mounted and wired on a front board covered with plastic fabric grille and ready for cabinet mounting. Available in 4 ohm, 8 ohm or 16 ohm impedance.



4-30 PABS

4-30 PABS (also available as KIT, see below).
is a 3-way speaker system consisting of 4 speakers and crossover network.
Max. Power Input: 30 Watts.
Frequency Range: 30–18000 c.p.s. in 50 litres (1.75 cb. ft.) cabinet.
Speakers: Woofer D 120 W special. Mid Range O 570 MRC.
Tweeters 2 × MT 25 HFC.
Crossover Frequencies: 500 and 3500 c.p.s.
Dimensions (inside) for 50 litres cabinet: Approximately 24⅛″ × 13⅜″ × 9¼″ (630 × 340 × 234 mm.).
Brown coloured plastic fabric grille.

2-8 PABS (also available as KIT, see below).
is a 2-way speaker system consisting of 2 speakers and crossover network.
Max. Power Input: 8 Watts.
Frequency Range: 50–18000 c.p.s. in 16 litres (0.57 cb. ft.) cabinet.
Speakers: Woofer B 65 W. Tweeter MT 25 HFC.
Crossover Frequency: 4000 c.p.s.
Dimensions (inside) for 16 litres cabinet: Approximately 15⅜″ × 9⅜″ × 6½″ (395 × 245 × 165 mm.).
Specify grey or golden coloured plastic fabric grille.

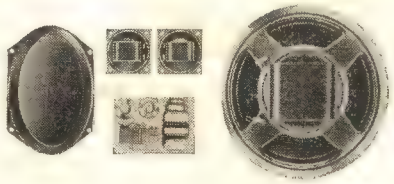
2-10 PABS (not available as KIT).
is a 2-way speaker system consisting of 2 speakers and crossover network.
Max. Power Input: 10 Watts.
Frequency Range: 50–18000 c.p.s. in 6.5 litres (0.23 cb. ft.) cabinet.
Speakers: Woofer O 525 WL. Tweeter MT 20 HFC.
Crossover Frequency 3500 c.p.s.
Dimensions (inside) for 6½ litres cabinet: Approximately 9¹⁵⁄₁₆″ × 6½″ × 6⅜″ (252 × 158 × 167 mm.).
Dark coloured plastic fabric grille.

3-15 PABS (also available as KIT, see below)
is a 3-way speaker system consisting of 3 speakers and crossover network.
Max. Power Input: 15 Watts.
Frequency Range: 45-18000 c.p.s. in 30 litres (1.06 cb. ft.) cabinet.
Speakers: Woofer P 825 W. Mid Range GT 50 MRC. Tweeter MT 20 HFC.
Crossover Frequencies: 750 and 4000 c.p.s.
Dimensions (inside) for 30 litres cabinet: Approximately 20⅜″ × 8⅜″ × 10½″ (515 × 218 × 270 mm).
Specify grey or golden coloured plastic fabric grille.

3-25 PABS (also available as KIT, see below).
is a 3-way speaker system consisting of 3 speakers and crossover network.
Max. Power Input: 25 Watts.
Frequency Range: 40–18000 c.p.s. in 100 litres (3.5 cb. ft.) cabinet.
Speakers: Woofer CM 120 W. Mid Range G 50 MRC. Tweeter MT 20 HFC.
Crossover Frequencies: 750 and 4000 c.p.s.
Dimensions (inside) for 100 litres cabinet: Approximately 25″ × 15″ × 16¼″ (635 × 380 × 412 mm.).
Specify grey or golden coloured plastic fabric grille.

Peerless LOUDSPEAKER SYSTEMS IN KITS FOR MONO AND STEREO

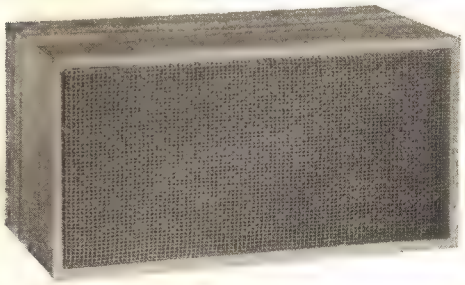
If you want to spend a little extra time to establish your high-fidelity sound system and at the same time save money, you can get four of our PABS systems in KITS.
A KIT system consists of speakers, crossover network, drawing of cabinet as well as mounting instructions, but without baffle.
Available in 4 ohm, 8 ohm or 16 ohm inpedance.



4-30 KIT

Peerless HI-FI CABINET SPEAKERS FOR MONO AND STEREO

A trio of 2-way and 3-way compact speaker systems in oiled teak cabinets of bookshelf type, Danish design and technique at its very best.
Available in 4 ohm, 8 ohm or 16 ohm impedance.



2-10A MEDIUM SIZE SYSTEM

2-10 COMPACT SYSTEM
is a 2-way speaker system in cabinet with dark coloured plastic fabric grille. Combines one special woofer (5¼″), one closed-back tweeter (2″) and a crossover network. Crossover Frequency: 3500 c.p.s. Frequency Range: 50–18000 c.p.s. Power Capacity: 10 Watts. Cabinet Size: 10¼″ × 6⅜″ × 8⅜″ (260 × 156 × 213 mm.).

2-10A MEDIUM SIZE SYSTEM
is a 2-way speaker system in cabinet with brown coloured plastic fabric grille. Combines one special woofer (6½″ × 10½″ elliptical), one closed-back tweeter (2½″) and a crossover network. Crossover Frequency: 3500 c.p.s. Frequency Range: 40–18000 c.p.s. Power Capacity: 10 Watts. Cabinet Size: 19¾ × 9⅞″ × 10⅜″ (500 × 250 × 270 mm.).

4-30 MONITOR SYSTEM
is a 3-way speaker system in cabinet with brown coloured plastic fabric grille. Combines one special woofer (12″), one special mid range (5″ × 7″ elliptical), two closed-back tweeters (2½″) and a crossover network. Crossover Frequencies: 500 and 3500 c.p.s. Frequency Range: 30–18000 c.p.s. Power Capacity: 30 Watts. Cabinet Size: 25⅜″ × 14⅜″ × 11⅞″ (650 × 360 × 300 mm.).

MADE BY

PEERLESS FABRIKKERNE A/S

COPENHAGEN · DENMARK

Distribution in the U.K. by
C. E. Hammond & Co. Limited - 90 High Street,
Eton Windsor, Berkshire

Please send me details of Peerless
☐ CABINET SPEAKERS ☐ PABS ☐ KITS
Mr. .....
Address .....
.....
Post to C. E. Hammond & Co. Ltd., 90 High Street, Eton Windsor, Berkshire. September WW 1967

WW—016 FOR FURTHER DETAILS

Pinnacle can assist all electronic valve users

ROUTINE

ECC83/12AX7: 2D21/EN91: 6AK5W/M8100: ECF82/6U8

We supply many thousands of these and similar everyday valves to both small and large equipment manufacturers.

DIFFICULT

6AW8A: 6DK6/8136: 5642: 12BY7A

Users of American Instrumentation rely upon us to provide a speedy replacement service in valves not easily obtainable in this country.

SPECIAL

CV4010: CY2578: CV2134

The special needs of Government Establishments and Departments are regularly catered for by us. Our stocking policy ensures positive ability to supply even obscure types.

UNUSUAL

A.R.B.: M.O.A.

We maintain stocks of valves approved by the Air Registration Board and Ministry of Aviation making available an "off-the-shelf" service in released items for the first time.

OUR ORGANISATION draws upon the resources of electronic valve manufacturers all over the world. It responds immediately to your requirements. A catalogue of over 1,000 specific types is available to bona-fide users through the Wireless World reader service.

Pinnacle

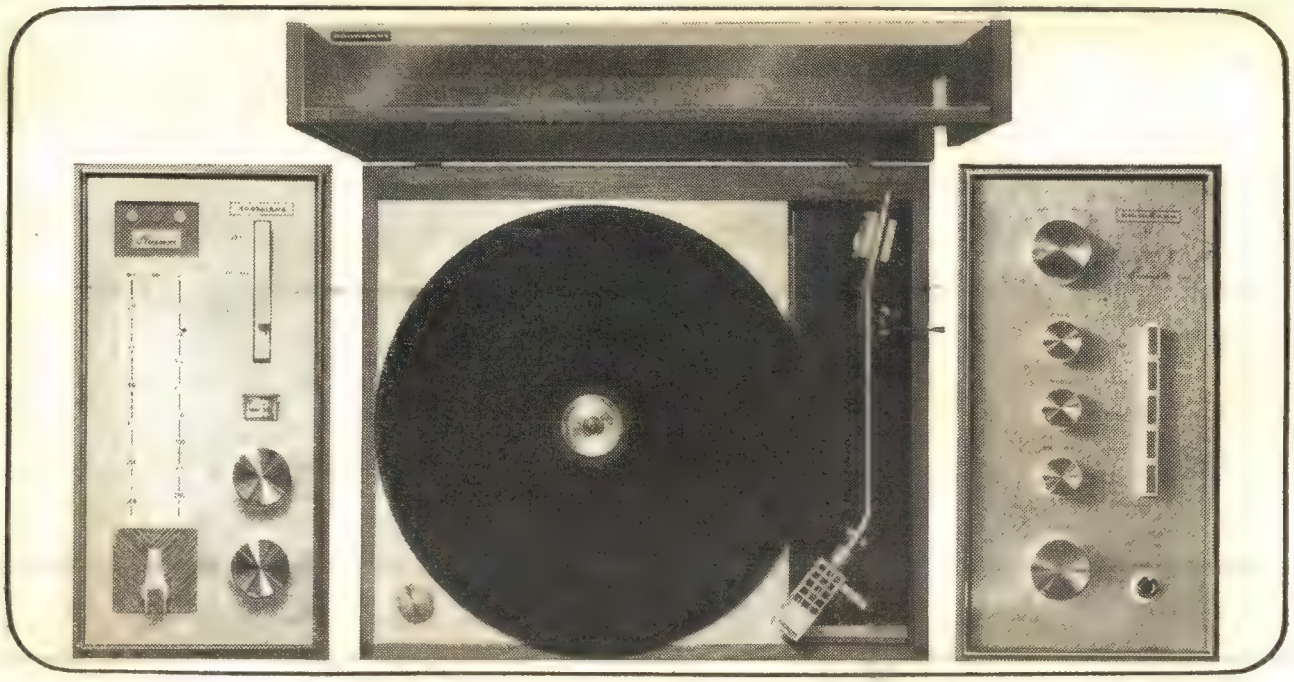
PINNACLE ELECTRONICS LTD

ACHILLES STREET · NEW CROSS · LONDON S.E.14

Tel: Tideway 7285

WW—017 FOR FURTHER DETAILS

audiosuite BY GOODMANS



Take a 'top-flight' amplifier, choose your loudspeaker from a quality-proven High Fidelity range, add a Tuner designed and built by experts and a Record Player guaranteed by Goodmans and there you have it—the most compact, adaptable, handsome *and* the most technically advanced audio system in the world. This is the AUDIO SUITE—by GOODMANS.

Ignore if you will, the handsome appearance, the compactness, the versatility of the Audio Suite. Judge it on the specification and performance alone.

Send for full technical details included in the Goodmans High Fidelity Manual. When you've read all about it—go and see it in the flesh and listen to a demonstration. Judge for yourself the simple sophistication of the controls and facilities, see how easy they are to use.

The Audio Suite is made up of:—Maxamp 30 Stereo Amplifier, Stereomax AM/FM Stereo FM Radio Tuner, MT1000 precision Record Player complete with arm and cartridge. Add to these a pair (for stereo) of the M-range loudspeakers—to *your* choice (these are—MAXIM, MEZZO and MAGNUM)—and you are 'away' with the finest set of audio equipment made.

Choose from the outstanding Goodmans range of High Fidelity products—and be sure of the best money can buy. See your Goodmans dealer or send the coupon for your copy of Goodmans High Fidelity Manual.

AUDIO SUITE PRICES
MAXAMP 30 £49.10.0
STEREOMAX £60+£11.18.3. P.T. inc. Surcharge
MT1000 £49.2.0+£8.13.3. P.T. inc. Surcharge
MEZZO II £28.7.0
or **MAXIM £15**+£2.15.7. P.T. inc. Surcharge
or **MAGNUM-K £36.15.0**
Audio Suite units are finished in Teak or Walnut to order.

FREE Please send me a free copy of Goodmans High Fidelity Manual and the name and address of my nearest Goodmans dealer.

Name_____

Address_____

WW9

GOODMANS LOUDSPEAKERS LTD · AXIOM WORKS · WEMBLEY · MIDDX. Tel: 01-902 1200

WW—018 FOR FURTHER DETAILS

Wireless World

ENQUIRY SERVICE FOR PROFESSIONAL READERS

To obtain further details of any of the coded items mentioned in the Editorial or Advertisement pages of this issue, please complete one or more of the attached cards entering the reference number(s). Your enquiries will be passed on to the manufacturers concerned and you can expect to hear from them direct, in due course. Cards posted from abroad require a stamp. **These Service Cards are valid for six months from the date of publication.**

PLEASE USE CAPITAL LETTERS

Weitere Einzelhelten über irgendwelche Artikel, die auf radaktionellen oder Anzeigenseiten erschienen erhalten Sie, indem Sie eine oder mehrere der beigefügten Karten ausfüilen und die Kennummer(n) angeben. Ihre Anfrage wird an den Herste ler weitergeleitet, und Sie werden dann direkt von ihm hören. Karten, die im Ausland aufgegeben werden, müsen frankiert werden. **Diese Service-Karten sind sechs Monate vom Ausgabetag gültig.**

BITTE IN BLOCKCHRIFT AUFÜLLEN

Per ulteriori particolari in merito agli articoli menzionati nel testo o nelle pagine pubblicitarie di questo numero. Vi preghiamo di completare una o pi ù delle schede allegate citando il numero o i numeri di riferimento. La Vostra richiesta sarà inoltrata ai fabbicanti interesati che Vi risponderanno direttamente. Le schede dall'estero devono essere regolarmente affrancate. **Questo scontrino di servizio é valido per sei mesi dalla data di pubblicazione.**

SI PREGA DI COMPILARE LE SCHEDE STAMPATELLO

Pour obtenir tout renseignement complémentaire sur les produits mentionné dans les articles ou dans les pages publicitaires de ce numéro, nous vous prions de remplir une ou plusieurs des cartes ci-jointes en inscrivant le ou les numéros de référence. Vos demandes de renseignement seront transmises aux fabricants intéréssés qui, en temps voulu, vous feront parvenir une réponse. Il est nécessaire d'affranchir les cartes postées à l'étranger. **Ces cartes de service sont valides pendant six mois à patir de la date du publication.**

PRIÈRE D'ECRIRE EN LETTRES MAJUSCULES

Con objeto de obtener más detalles de cualquiera de los articulos mencionados en las páginas editoriales o de anuncios de este número sirvase rellenar una o más de las unidas tarjetas citando el número o números de referencia. Sus consultas serán transmitidas a los fabricantes interesados de quines tendrán noticias directamente a su debido tiempo. Las tarjetas enviadas desde el extranjero requieren franqueo. **Estas tarjetas de servicio son validas durante 6 meses a parir de la fecha de publicacion.**

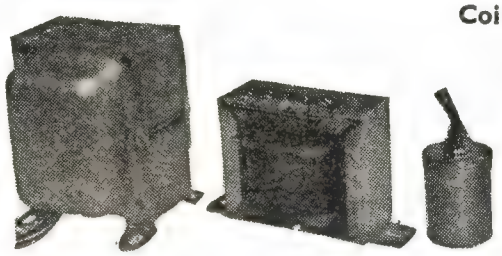
SIRVASE ESCRIBIR CON LETRAS MAYUSCULAS

10–12 Watts — 5 kVA

DRAKE TRANSFORMERS

INCORPORATING R. F. GILSON LTD.

Mains Transformers
Chokes
Audio Output Transformers
Audio Input Transformers
Saturable Reactors
Coils
Current Transformers
Transistor Transformers
Inverter Transformers
Screened Microphone Transformers
Wide Band R.F. Transformers



DRAKE TRANSFORMERS LTD., BILLERICAY, ESSEX

Billericay 1155

WW—019 FOR FURTHER DETAILS

New Tektronix Type 556

DC-to-50 MHz, dual-beam, sweep-delay oscilloscope

The Type 556 and rack-mount Type R556 use any combination of Tektronix letter or 1-series plug-ins

The UPPER BEAM can display a signal from either *left* or *right* plug-in; with either Time Base A, Time Base B, or external signals; triggered from a composite vertical signal, plug-in single channel signal (with 1A1 or 1A2), external, or line.

The LOWER BEAM can display a signal from the *right* plug-in; with either Time Base B or external signals; triggered from a composite vertical signal, plug-in single channel signal (with 1A1 or 1A2), external, or line.

Independent Vertical Systems use Type 1A1 or 1A2 Plug-in Units for 50 MHz operation; also accept any other 1-series or letter-series plug-in units.

Independent Sweep Systems provide 24 calibrated steps from 0.1 μs/cm to 5s/cm; the X10 Magnifier extends the fastest sweep rates to 10ns/cm.

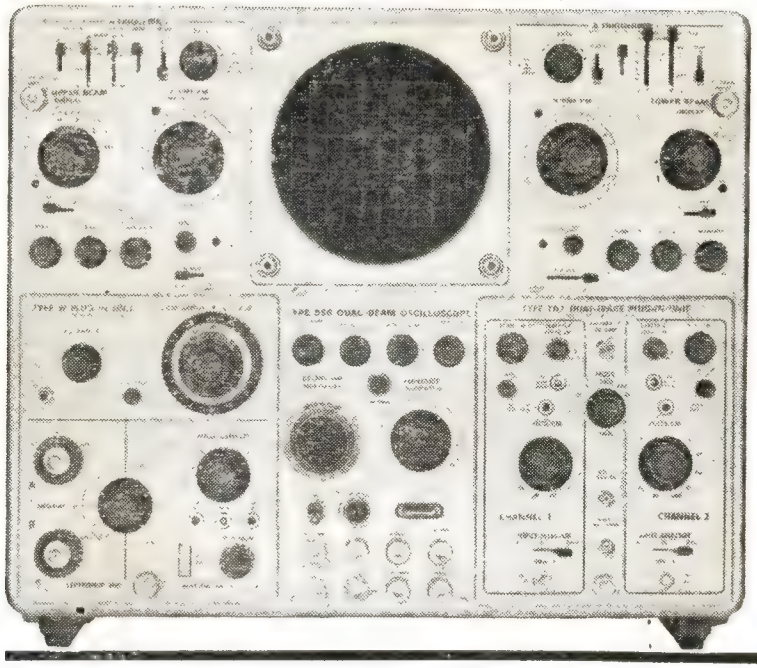
Calibrated Sweep Delay extends continuously from 0.1 microsecond to 50 seconds.

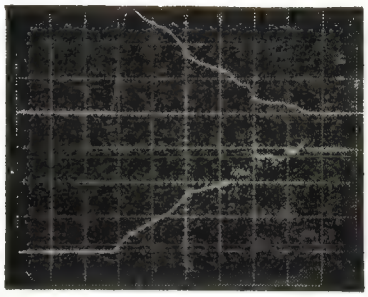
Signal-Sweep Operation enables one-shot displays of normal or *delayed* sweeps.

Independent Triggering Systems provide stable displays to beyond 50MHz. Either input signal can be used to trigger either or both time-bases.

New Dual-Beam CRT (with illuminated internal graticule) provides "zero-parallax" viewing of small spot size and uniform focus over the 8cm by 10cm display area. Each beam has 6cm vertical scan, with overlap scan of 4cm by 10cm.

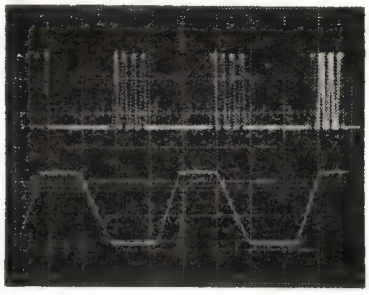
EMI (RFI) Suppression — meets interference specifications of MIL-I-6181D over these frequency ranges: 150kHz to1GHz — Radiated (with CRT mesh filter installed), and 150kHz to 25MHz — Conducted (power line).





Simultaneous Single-shot Displays.

Current versus voltage display of a 0.75 ampere, fast-blow fuse during destructive overload. Both beams are driven by B Time-Base at 50μs/cm which is delayed by pre-triggered A Time-Base to provide base reference lines before and after the event. The upper beam shows the current waveform at 30A/cm while the lower beam shows the corresponding voltage across the fuse at 100V/cm.



Single-input Dual-beam Displays.

Upper beam shows **bursts of 2.5MHz pulses** on Time Base A with time variation between bursts. This shows up as increasing time-jitter between the first and successive bursts. The lower beam shows B Sweep (0.1μs/cm) delayed by A Sweep and triggered on the second pulse of the last burst to provide a jitter-free expanded display of the A Sweep intensified zone. The use of only one probe and one plug-in input simplifies signal connection and provides minimum loading on the source.

Plug-in units shown

Type 1A1 Dual-trace Unit
(Dual-Trace—50mV/cm at DC-to-50 MHz. 5mV/cm at DC-to-28 MHz. Single-Trace—500μV/cm at 2Hz-to-15 MHz. 5 Display Modes—Channel 1, Channel 2, Alternate, Chopped, Added Algebraically. Front-panel signal output.)

Type W Differential Comparator Unit
(*Conventional Preamplifier* 50mV/cm at DC-to-23MHz to 1mV/cm at DC-to-8MHz. Decade Input Attenuator to X1000. *Differential Input-Preamplifier*—CMRR of 20,000 to 1. DC-to-20kHz. Max Peak Input of ±15V, X1 Attenuation. *Calibrated Differential Comparator*—Vc Supply of 0 to ±11V. Accuracy of ±0.15% of output ±0.05% FS.)
Price without plug-in units—£1,300.

For detailed information on any of our products, please fill in reader reply card or write, telephone or telex.

Tektronix U.K. Ltd.

Beaverton House · Station Approach · Harpenden · Herts
Telephone: Harpenden 61251 · Telex: 25559

For overseas enquiries:

EUROPE AND THE MIDDLE EAST: Tektronix Ltd., P.O. Box 36, St. Peter Port, Guernsey, C.I.

CANADA: Tektronix Canada Ltd., Montreal, Toronto & Vancouver.

AUSTRALIA: Tektronix Australia Pty. Ltd., 4-14 Foster Street, Sydney, N.S.W.

SWITZERLAND: Tektronix International A.G., P.O. Box 57, Zug, Switzerland.

All other territories: Tektronix Inc., P.O. Box 500, Beaverton, Oregon, U.S.A.

WW—020 FOR FURTHER DETAILS

TIMERS MICRO SWITCHES
IMMEDIATE DESPATCH

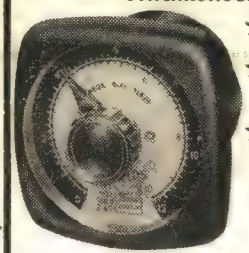
PROCESS TIMERS

611-T Delay Relay

★ 2, 5, 15 & 25 secs. Delay
★ 15 amp. c/o micro-switch fitted
★ LARGE RANGE OF A.C. & D.C. COILS.

approx. **40/-** each, dependent on quantity.

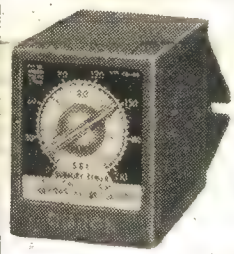
LATEST ADDITION **SYS MINI-TIMER**
SYNCHRONOUS MOTOR & CLUTCH



★ 10 MILLION OPERATIONS
★ Instantaneous & Timed out 3 AMP contacts
★ Repeat Accuracy ±½%. 10 secs. to 28 Hrs. May also be used as impulse start and automatic reset.

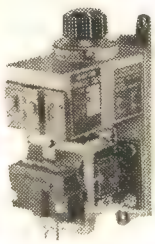
approx. **£9.15.0** dependent on quantity.

STP Sub-Mini Process Timer
SYNCHRONOUS MOTOR & CLUTCH



Matchbox size frontal area
Automatic Re-set
★ PLUG-IN OCTAL BASE
★ INSTANTANEOUS AND TIMED OUT 2 AMP CONTACTS
★ RANGES: 10 SECS. TO ½ HOUR.
MAINS OPERATION

approx. **£5.0.0** each.



AT-10
PNEUMATIC TIMER- delay relay

★ Fully adjustable up to 200 seconds. Fitted with 15 amp. S.P.D.T. switch.
★ One model provides delay after energise or delay after de-energise.

approx. **£6.0.0** dependent on quantity.

PROXIMITY SWITCH—YL 2 GPA

REQUIRES NO POWER PACK
★ FOR BATCHING, CONVEYORS, MACHINE TOOL CONTROL, PACKAGING, SORTING, etc.
★ SENSES FERROUS OBJECTS
★ NEEDS NO MECHANICAL FORCE OR PRESSURE TO OPERATE
★ SOLID STATE SENSING HEAD INCLUDES CONSTANT VOLTAGE CIRCUIT

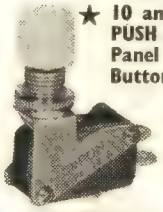
OPERATES DIRECT FROM MAINS SUPPLY. approx. **£11.0.0** dependent on quantity

U.L. APPROVED (Appr. No. 32667) U.S. MIL. SPEC.
ALWAYS AVAILABLE FROM STOCK

S5G

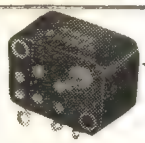
★ 1 MILLION OPS.
5 amp. c/o Sub-miniature Micro-switch.
2/5 each per 1,000

VAQ



★ 10 amp. c/o PUSH BUTTON Panel mounting. Buttons in six colours.
4/2 each per 250.

C-5



★ LOW TORQUE PRECISION ROTARY SWITCH
★ 5 amp. c/o
★ ½ million operations
6/3 each per 1,000

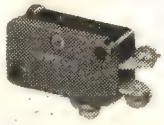
VV-15-1A

★ 15/10 amps. c/o
★ 100,000 ops.
1/8 each per 1,000
Single Throw 1/6 each

LIMIT SWITCH WL 10 FNJ

★ 10 AMP 2 CIRCUIT
★ 5 INCH FLEXIBLE ACTUATOR
AS ILLUSTRATED
FIVE OTHER STANDARD TYPES AVAILABLE AS LOW AS **44/-** EACH.

V-10-1B



★ 1 MILLION OPERATIONS.
★ 10 amp. c/o.
★ COMPARE OUR SPEC. & OUR PRICES WITH OTHER SIMILAR TYPES.
Screw Terms. **2/2** each per 1,000
V-10-1A Solder Tags 1/11 each per 1,000

VV-5GW-1A44

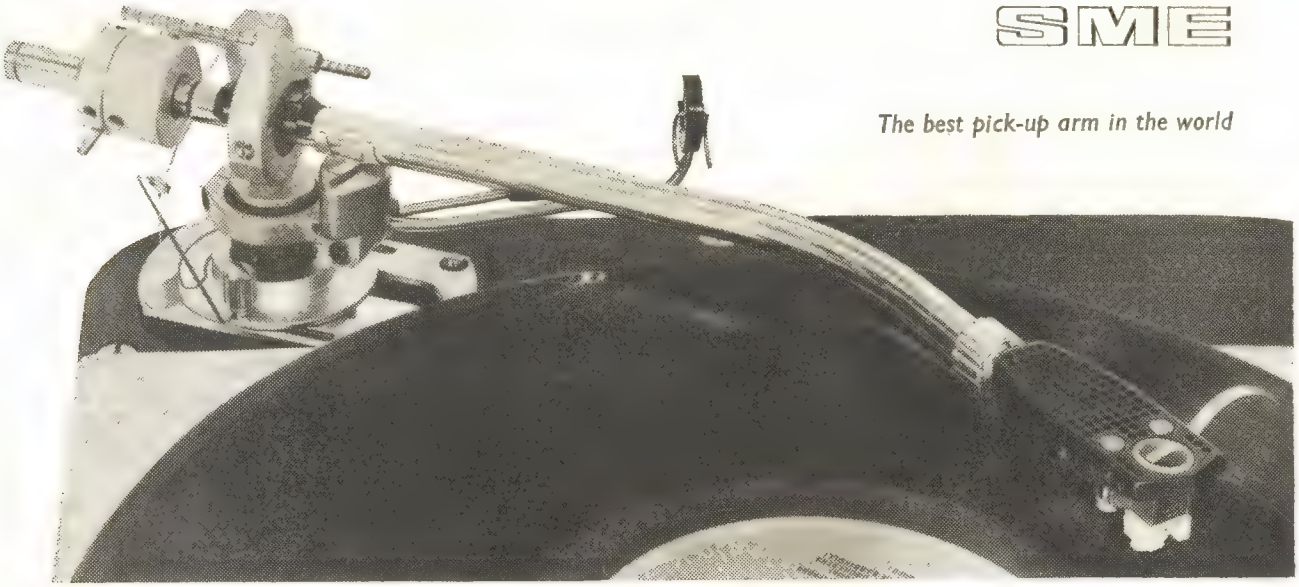
★ LIGHT FORCE
★ 4 gms. Wire actuator.
★ Designed for coin-operated mechanisms.
4/1 each per 1,000

★ NORTHERN STOCKISTS: *GORDON WILSON (AUTOMATION) LTD. BLACKBURN 59921.* ★ SOUTHERN STOCKISTS: *EDMUNDSONS ELECTRONICS LTD. NEW CROSS 9731.* ★ MIDLAND STOCKISTS: *B.P.G. ELECTRO-MECHANICAL SUPPLY CO. LEICESTER 61460.* ★ N.W. STOCKISTS: *A. C. FARNELL LTD. LEEDS. 35111.* ★ *GAWT DISTRIBUTORS LTD. ORCHARD GROVE 3484,*

(Dept. W.W.9) **OMRON PRECISION CONTROLS**
313 Edgware Road, London, W.2 **Tel.: Paddington 2370**

SME

The best pick-up arm in the world



Only S.M.E. Precision Pick-up Arms offer all these features · Choice of arm length Model 3009 (9in.) or Model 3012 (12in.) for still lower tracking error—of special importance with elliptical styli · Low inertia · High precision ball races and knife-edge bearings for minimum pivot friction · Linear offset chosen for lowest distortion · Automatic slow-descent with hydraulic control · Bias adjuster calibrated for tracking force · Exact overhang adjustment with alignment protractor · Precise tracking force from ¼-5 grams applied without a gauge · Shielded output socket · Low capacity 4ft. connecting cable with quality plugs · Light-weight shell · Camera finish in satin chrome, gun-black and anodised alloy · Comprehensive instructions · Rational development—all improvements can be incorporated in any existing Series II arm.

For sales and service ring Steyning 2228.

S M E LIMITED · STEYNING · SUSSEX · ENGLAND

WW—022 FOR FURTHER DETAILS

Hi-Q
LOW LOSS
PRECISION
LIGHT-WEIGHT
AIR-WOUND

A series of precision, air spaced inductors, available in diameters from ¼" to 3" and a wide range of inductances.

CODAR-COILS

are the only complete range of air-spaced precision inductors available today on short delivery. Specials to specification can be supplied and prototype samples are available to designers.

Brochure giving data of types/inductance—capacity-frequency on request.

CRC

CODAR RADIO COMPANY
Bank House · Southwick Square
Southwick · Sussex
'phone · Southwick 3149

Suppliers to:
H.M. Govt., Industry, Laboratories and Universities throughout the world.

WW—023 FOR FURTHER DETAILS

FILTER TIPS

Brush Clevite can give you the best tips on Bandpass Filters

They make them in U.K. *and* they are down in price. There are major reasons why Clevite's growing family of ceramic filters are replacing LC, quartz and mechanical filters in a broad range of military and commercial equipment. Check these plus points for a start. Small. Lightweight. Rugged. Large range of band widths. Non-microphonic. Permanently tuned. Immune to magnetic fields. High stop band rejection and clean response. Highly stable with both temperature and time. There is a Clevite filter for almost every application. Take our tip. Write for up-to-date Bulletin Sheets TODAY.

Keep in touch with

BRUSH CLEVITE

BRUSH CLEVITE COMPANY LIMITED · THORNHILL · SOUTHAMPTON
TELEPHONE SOUTHAMPTON 48055 · TELEX 47687 · TELEGRAMS BRUDEV SOTON
CLEVITE CORPORATION PIEZOELECTRIC DIVISION
232, FORBES ROAD, BEDFORD, OHIO. 44014

WW—024 FOR FURTHER DETAILS

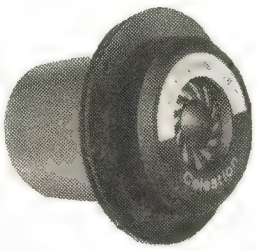
Your own speaker system?

The separate speaker approach

CHOOSE FROM THE Celestion HIGH FIDELITY RANGE

HF1300 Mk 2

"...just about the 'flattest' tweeter in the business"
(B. J. Webb, "Hi-Fi News", Feb. '67)



Frequency response 2–15 kHz
Recommended crossover frequency 3 kHz
Power handling—for systems rated up to 20 Watts r.m.s.
Impedance 15 Ohms at 10 kHz

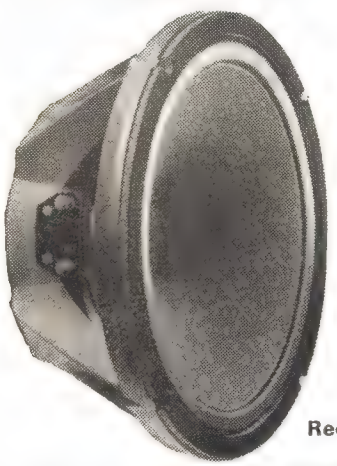
Recommended price £5.10.0

to complete the perfectly matched set...

CO3K Crossover Unit

Air-tight crossover and terminal assembly with filter network; 12db per octave cut off at 3 kHz

Recommended price £2.10.0



'Studio 12' Bass Loudspeaker

Frequency response 30–5,000 Hz
Power handling 15 Watts r.m.s.
Impedance 15 Ohms
Fundamental resonance 20 Hz

Recommended price £10.5.0

Celestion Studio Series loudspeakers for the perfectionist

ROLA CELESTION LTD.
Ferry Works, Thames Ditton, Surrey Tel: 01-398 3402

Please send me illustrated leaflets and fully dimensioned drawings for the home constructor.

*NAME*_____

*ADDRESS*_____

WW9/67

GD875

WW—025 FOR FURTHER DETAILS

M. R. SUPPLIES, Ltd.

(Established 1935)

Known for many years as the most reliable source of the following specialised material—always right up to date. Careful packing—immediate delivery. Prices nett.

EXTRACTOR FANS. Ring mounted all metal construction. T/E induction motor, silent operation. 8in. Blade, 10in. max. dia. 400 C.F.M. **£5/15/-** (des. 5/-). Same model 10in. Blade, 12in. max. dia. 500 C.F.M. **£6/6/-** (des. 5/-).

SMALL GEARED MOTORS. In addition to our well-known range (List GM.564), we offer small open type S.P. Units, 200/250 v. A.C., 1, 6, 12, 24, 60 r.p.m., approx. 5in. long with 1in. shaft projection each side and enclosed gearbox. Suitable for display work and many industrial uses. **Only 69/6** (des. 3/-).

SYNCHRONOUS TIME SWITCHES (Our very popular speciality). 200/250 v. 50 c. for accurate pre-set switching operations. Sangamo S.254 providing up to 3 on-off operations per 24 hours at any chosen time, with day-omitting device (use optional). Capacity 20 amps. Compactly housed 4in. dia., 3½in. deep, **£5/18/6** (des 4/6). Also same excellent make new Domestic Model, no wiring and easy setting and installation. Portable with lead and 13-amp. plug, same duty as above (less Day-omitting), **£4/9/6** (des. 4/6). Full instructions sent with each.

MINIATURE VARIABLE TRANSFORMERS (Philips). Remarkable higher duty mode for immediate delivery from stock. Enclosed type only 3½in. dia. Input 200/240 v. Output continuous 0/250 v. 0.7 amp., the perfect unit for controlling small motors, etc., **£4/8/6** (des. 3/6).

MINIATURE COOLING FANS. 200/250 v. A.C. With open type induction motor (no interference). Overall 4in. × 3½in. × 2¼in. Fitted 6-bladed metal impeller. Ideal for projector lamp cooling, light duty extractors, etc., still only **28/6** (des. 4/6).

MINIATURE RUNNING TIME METERS (Sangamo). We have great demands for this remarkable unit and can now supply immediately from stock. 200/250 v. 50 c. synchronous. Counting up to 9,999 hours, with 1/10th indicator. Only 1¼in. square, with cyclometer dial, depth 2in. Many industrial and domestic applications to indicate the running time of any electrical apparatus—easy to install, **60/-** (post paid).

AIR BLOWERS. Highly efficient units fitted inducation totally enclosed motor 230/260 v. 50 c. 1 ph. Model SD.26, 60 CFM (free air) to 11.5 CFM at .15 WG (size approx.) 6 × 6 × 7in. Outlets 2½in. square, **28/10/-** (des. 5/-). Model SD27, 120 CFM (free air) to 40 CFM at 1.2 WG, 8 × 7 × 9in., outlet 2½in. sq., **£11/15/6** (des. 5/-). Model SD28, 260 CFM (free air) to 127 CFM at 1.5 WG, 11 × 8 × 9in., outlet 3in. sq., **£13/17/6** (des. U.K. 7/6).

SYNCHRONOUS ELECTRIC CLOCK MOVEMENTS (as mentioned and recommended in many national journals). 200/250 v. 50 c. Self-starting. Fitted spindles for hours, minutes and central sweep seconds hands. Central one-hole fixing. Dia. 2¼in. Depth behind dial only 1in. With back dust cover, **29/6** (des. 1/6). Set of three brass hands in good plain style. For 5/7in. dial 2/6. For 8/10 dial 3/6 set.

SYNCHRONOUS TIMER MOTORS (Sangamo). 200/250 v. 50 c/s. Self-starting 2in. dia. × 1¾in. deep. Choice of following speeds: 1 r.p.m., 12 r.h.p., 1 r.p.h., 1 rev. 12 hours, 1 rev. per day. Any one **39/6** (des. 1/6). Also high-torque model (G.E.C.), 2¼in. × 2in. × 1¾in. 6 r.p.m., **57/6** (des. 1/6).

IMMEDIATE DELIVERY of **Stuart Centrifugal Pumps,** including stainless steel (most models), **Philips Variable Transformers** (all models).

M. R. SUPPLIES, Ltd., 68 New Oxford Street, London, W.C.1
(Telephone: 01-636 2958)

6mm tubular midget flange S6/8 cap over-all length 14.5 mm.

It is one of the many Vitality Instrument and Indicator Lamps that are made in an unusually large number of types, ratings and sizes. It may be just what you need for an existing or new project. If not, another from the hundreds of Vitality types and ratings may well be. Catalogue 66, free and post-free, details them all.

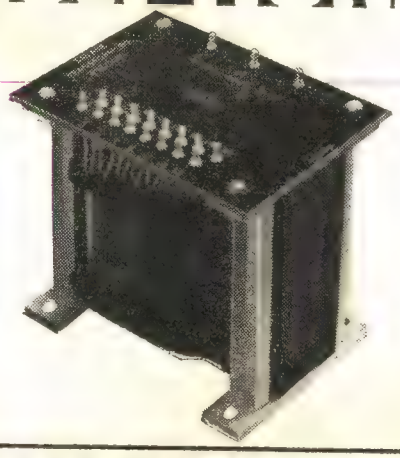
**Many a product owes its success to the intelligent addition of an indicator light.*

VITALITY BULBS

VITALITY BULBS LTD MINIATURE AND SUB-MINIATURE LAMP SPECIALISTS
BEETONS WAY, BURY ST. EDMUNDS, SUFFOLK. TEL. BURY 2071. S.T.D. 0284 2071

WW—026 FOR FURTHER DETAILS

EXCEPTIONAL



LIKE ALL SAVAGE AUDIO TRANSFORMERS

Designed for use with the Williamson amplifier, this transformer is exceptional in its performance, reliability and suitability for the job it does.

Not surprising really because it's exceptional in another sense, too. It's unique—like all transformers made by Savage, custom engineered to the buyer's individual specifications.

Please write if YOU have an audio transformer problem. If it's between our economic limits of 1 m/W (input) to 60 KW (output)—both up to 10 Kv, we can solve it.

Illustrated:

Plate to plate impedance: 10,000 ohms centre tapped. Secondary impedances: 0.45 ohms, 1.8 ohms, 4 ohms, 7 ohms, 11 ohms, 16 ohms, 22 ohms and 30 ohms. Primary inductance: 100 hys. Primary DC resistance: 90 ohms + 90 ohms. Leakage reactance: Primary to secondary 16 m/hys, half primary to secondary 8 m/hys. Power handling capacity: 15 watts at 12½ c/s.

savage

SAVAGE TRANSFORMERS LIMITED
Nursteed Road, Devizes, Wiltshire.
Telephone: Devizes 2132 Telex: 44285
Incorporating
DODD TRANSFORMERS LIMITED
Bradley Road, Trowbridge, Wiltshire.
Telephone: Trowbridge 5401 Telex: 44285
Members of the John James Group of Companies

WW—027 FOR FURTHER DETAILS

Your own speaker system?

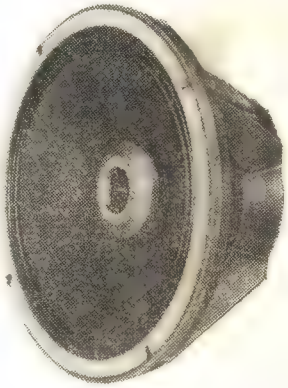
the co-axial approach

CHOOSE FROM THE Celestion HIGH FIDELITY RANGE

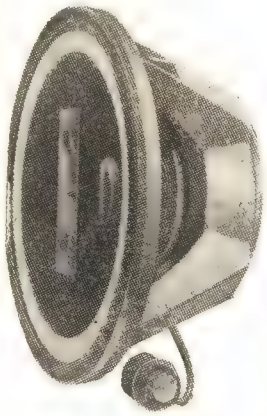
"... among my favourite speakers ..."
(Clement Brown "Records and Recording" December 1966)

CX 1512

12 inch co-axial loudspeaker with pressure-driven 'tweeter'



Frequency response 30–15,000 Hz
Power handling 15 Watts r.m.s.
Impedance 15–16 Ohms
Recommended price £12.5.0



CX 2012

12 inch co-axial loudspeaker with compression horn 'tweeter'
Frequency response 30–18,000 Hz
Power handling 20 Watts r.m.s.
Impedance 15–16 Ohms
Recommended price £17.10.0

Both these units feature:

- high flux ceramic magnets
- two voice coils
- pure electrical crossover
- high compliance surrounds

Celestion Studio Series loudspeakers for the perfectionist

ROLA CELESTION LTD.
Ferry Works, Thames Ditton, Surrey Tel: 01-398 3402

Please send me illustrated leaflets and fully dimensioned drawings for the home constructor.

NAME_____

ADDRESS_____

GD874 WW.9.67

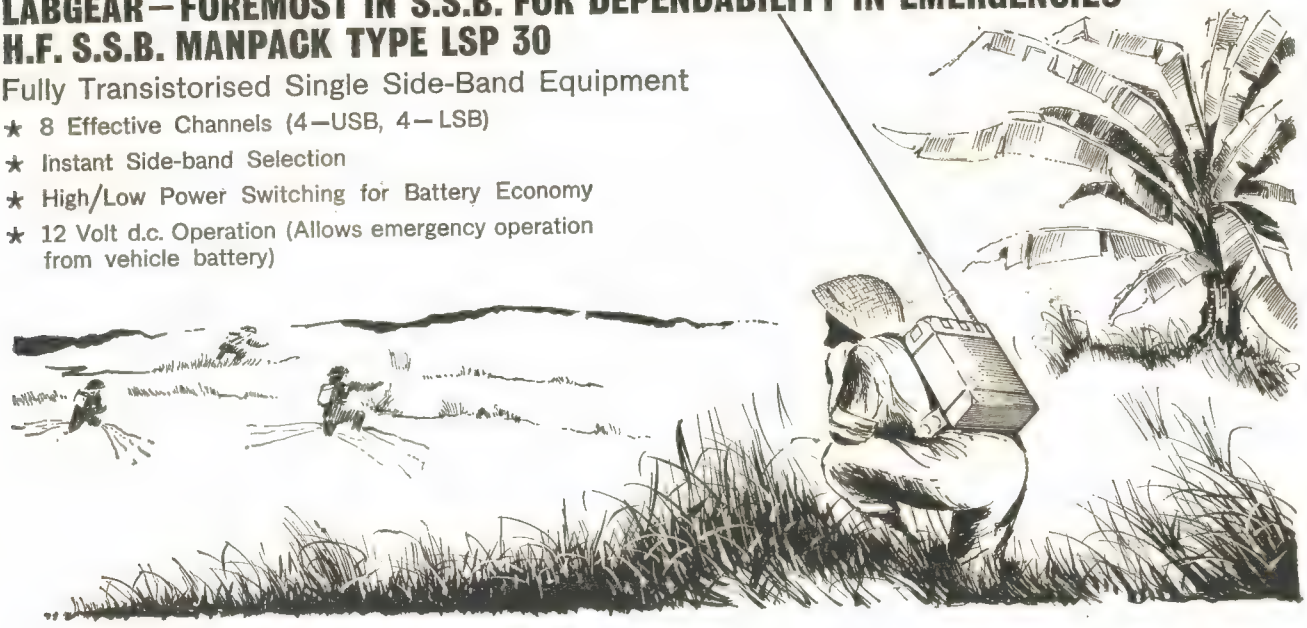
WW—028 FOR FURTHER DETAILS

LABGEAR—FOREMOST IN S.S.B. FOR DEPENDABILITY IN EMERGENCIES

H.F. S.S.B. MANPACK TYPE LSP 30

Fully Transistorised Single Side-Band Equipment

★ 8 Effective Channels (4—USB, 4—LSB)
★ Instant Side-band Selection
★ High/Low Power Switching for Battery Economy
★ 12 Volt d.c. Operation (Allows emergency operation from vehicle battery)



LABGEAR LIMITED CROMWELL ROAD
CAMBRIDGE ENGLAND
Telephone 47801 (4 lines)
Telegrams Labgear Cambridge
Telex: 81105 Lab

Labgear

LABGEAR

WW—029 FOR FURTHER DETAILS

THE PEMBRIDGE COLLEGE OF ELECTRONICS

FOR TRAINING IN RADIO AND TELEVISION

FULL-TIME COLLEGE COURSE IN RADIO AND TELEVISION

Our Course, of sixteen months' duration, provides a fundamental training for radio and television engineers. It includes theoretical and practical instruction on transistor television receivers, U.H.F. television receivers and colour television.

Exactly half the time is spent on practical work and the course provides excellent practical experience on valve and transistor radio receivers and high-fidelity equipment and all well known makes of television receivers.

The Course is recognised by the Radio Trades Examination Board (R.T.E.B.) for the Radio and Television Servicing Certificate examinations.

Next Course commences 5th Sept., 1967.

To: **The Pembridge College of Electronics (Dept. P10)**
34a Hereford Road, London, W.2.
Please send, without obligation, details of the Full-time Course in Radio and Television.

Name _____

Address _____

_____ CMP5

WW—030 FOR FURTHER DETAILS

Why is Filmet® FM70 the only metal-film resistor with D E F Qualification Approval throughout the range?

ACTUAL SIZE

Because we have not yet submitted FM65 and FM75

Filmet type FM70 is the first metal-film resistor to obtain Qualification Approval to DEF 5115-1 style RFG7-0.5 over the full range of approved resistance values.

It is one of a range of six Filmet resistors which offer the highest levels of operating stability in wattage ratings from 0.25w to 1.0w at 70°C.

Every Filmet resistor is manufactured in our temperature, humidity and dust controlled clean air unit, one of the finest installations of its kind in Europe.

Filmet quality and reliability are continuously assessed in our approved environmental test house. Total reliability is guaranteed.

Put your trust in Filmet.

Send us the coupon and let us tell you more.

® 'FILMET' is a Registered Trade Mark of Morganite Resistors Limited.

Please send me full details of Filmet metal-film resistors

NAME..... POSITION.....

COMPANY.....

ADDRESS..... W.W.

Morgan MORGANITE RESISTORS LIMITED

Bede Trading Estate, Jarrow, Co. Durham. Tel: Jarrow (ONE-2) 897771. Telex: 53353

1966 THE QUEEN'S AWARD TO INDUSTRY

WW—031 FOR FURTHER DETAILS

you can't afford to be without these catalogues

so send for them TODAY!

PLUGS, SOCKETS AND CONNECTORS CATALOGUE.
70 pages containing details of over 100,000 different types of British and American plugs, sockets and connectors by A.E.I., Amphenol, 'AN' Series, Belling-Lee, Bendix, Bicc-Burndy, Burndept, Bulgin, Cannon, Elcom, Electro Methods, Ether-Winchester, Greenpar, Harvey Hubbel, Magnetic Devices, McMurdo, 'MS' Series, Niphan, Painton, Paton, P.E.T., Plessey, Pyle, Smart & Brown, Smiths, Superflexit, Thorn, Transradio, Ultra, U.S. Military & Nato Cross Reference Guide.
Presented in alphabetical order with a rapid reference guide for quick and simple location of particular types.
Considered by the technical press to be a work of reference and backed by a unique 48 hour delivery service.

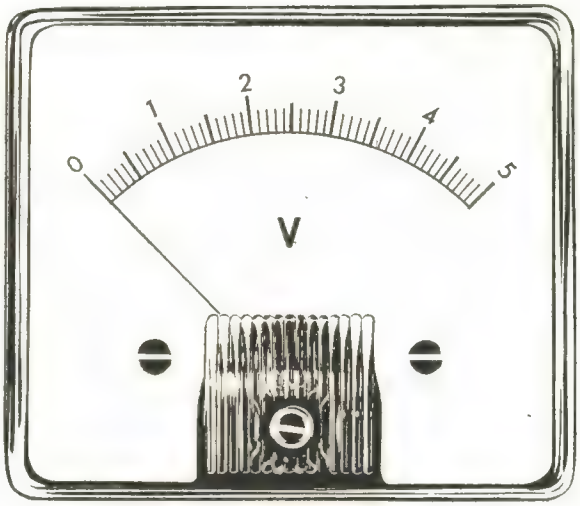
CATALOGUE OF INDUSTRIAL ELECTRONIC COMPONENTS
76 pages of Transistors, Valves, Diodes, Rectifiers, Crystals, Klystrons, Magnetrons, A.C. and D.C. Motors, Generators, Relays, Pressure Gauges, Cathode Ray Tubes, Resistors, Transformers, Tantalum Capacitors, Transducers, Accelerometers, Tachogenerators, Pen Recorders, Servo Components, Servo and Synchro Motors, Actuators, Test Equipment, Waveguide Equipment, Decade Counters, etc., etc.

WE REGRET THAT WE ARE UNABLE TO SEND CATALOGUES TO PRIVATE ADDRESSES.

LIND-AIR ELECTRONICS LTD
53 Tottenham Court Road, London, W.1
Telephone : 01-580-4532 Telex : 27931

WW—032 FOR FURTHER DETAILS

METER PROBLEMS?



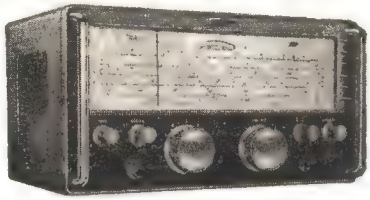
A very wide range of modern design instruments is available for 10/14 days delivery.

Full information from:
HARRIS ELECTRONICS (London) LTD.
138 GRAYS INN ROAD, W.C 1. Phone: 01/837/7937

WW—033 FOR FURTHER DETAILS

EDDYSTONE COMMUNICATION RECEIVERS

For the professional or Amateur user who likes the Best.



840C
£66

HIRE PURCHASE TERMS

Model	Cash Price	Deposit	12 mthly. of	Total H.P Price	24 mthly. of	Total HP Price
EC10	£53	£18	£3 2 8	£55 12 0	£1 13 6	£58 4 0
840C	£66	£22	£3 18 7	£69 3 0	£2 1 11	£72 6 0
EB35	£60 6 3	£20 6 3	£3 11 8	£63 6 3	£1 18 4	£66 6 3
940	£133	£45	£7 17 8	£139 12 0	£4 4 4	£146 4 0
EA12	£185	£62	£11 4 0	£194 4 0	£5 17 11	£203 10 0

CARRIAGE PAID

SEND 6d STAMP FOR LITERATURE TO

The Eddystone Specialists

HP RADIO SERVICES LTD.
51 COUNTY ROAD LIVERPOOL, 4

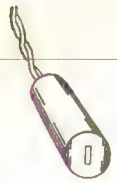
Telephone: AINTREE 1445 *ESTAB. 1935*

WW—034 FOR FURTHER DETAILS

MAGNETIC RECORDING

HEADS

TYPE "A"

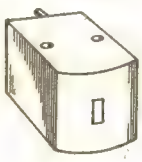


Standard 1/2 track, Record/Playback and Erase. Many special versions can be made to customers' requirements such as narrow track—raised track—or cut-away for cine use. Ideal head for dictating machines, etc. Size ⅜in. dia. by ⅜in. long. The round body makes for easy azimuth adjustment and takes up a minimum of space. Head has internal screen and fly leads for easy wiring.

TYPE "R"

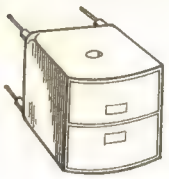
Size is 7/16in. square at the front with body ⅜in. dia. by ⅜in. long. Curved front 1½in. radius. This head is available in a wide range of Record/Playback impedances. Also available as Erase. This novel design possesses many advantages over comparable types — higher output — lower losses— extremely good H.F. response—very low noise pick up—has internal mumetal screen. Round body aids mounting arrangements—easy azimuth alignment.

TYPE "DR"



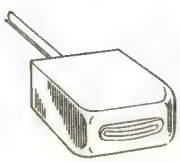
Exactly as Type R except body is 7/16in. square along its length providing simple mounting arrangements. The Erase versions of R and DR types are double field heads. These are not just double gaps but two Erase heads in one, giving better than 60dB erasure of a saturation (+6dB on full record level), 1 k/c recording at 3¾ i.p.s.

TYPE "X"



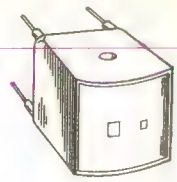
1/1 — 1/2 — 2/2 and 2/4 Heads for ¼in. tape. Record/Playback and Erase Heads for high quality tape recorders. Size only ½in. cube and available in a whole range of impedances. Excellent HF performance, efficient screening and very low cross-talk are features of the R/P head. Mounting brackets are available for twin or triple head assemblies.

TYPE "T"



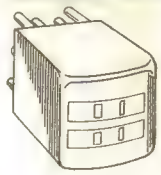
Built into a deep drawn mumetal case ensures complete shielding. Type T is the protruding pole type with special narrow track (as narrow as .002in.) and can be made as a Record/Playback or Erase Head, or combined Record/Playback/Erase Head, or even Record/Playback and self-oscillatory Erase Head. The Erase track can be made wider than the R/P track on the Combo Head, a fully screened lead is incorporated as part of the head.

SINGLE TRACK COMBO TYPE "X"



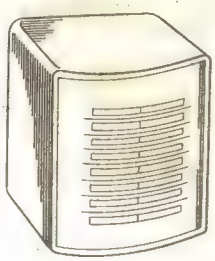
Designed as a combined Record/Playback/Erase Head for the commercial market, such as telephone answering machines. Built into ½in. cube deep drawn mumetal case it incorporates the R/P features of R-Type head. The Erase track is made wider than the R/P track to ensure complete erasure and to overcome machine to machine alignment tolerances.

TYPE "Z"



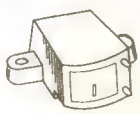
A brand new concept in combination head design incorporating all the best features of the X-Type head combined with integral erase facilities. Accurate gap alignment between tracks makes this head eminently suitable for high quality stereo use. The one piece deep drawn mumetal case (only ½in. cube) ensures complete screening across the front as well as the sides.

MULTITRACK



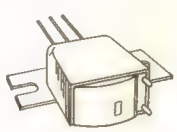
Available to special order in Two-Four-Eight or Sixteen tracks, or to specification. These tracks are located by precision machined slots and track dimensions and positions remain consistent. The track to fixing base dimensions are held to tight limits and any tolerances are non-cumulative as each track is indexed from the base. Special purpose optical equipment ensures a high order of accuracy in the alignment of the head halves. Erase heads, identically sized to the R/P head are available to special order.

TYPE "W" ERASE



Designed especially for the Cassette Type Recorder using .15in. wide tape. Built-in tape guides are a feature of this head. The Standard type now in production is ¼-track but a compatible Stereo version will soon be available. The high Q factor of Type W Erase gives maximum economy in battery applications.

TYPE "W" R/P.



The Record/Playback Head for Cassette Recorder incorporated in a deep drawn mumetal case ensuring complete screening. As an integral part of the head the mounting plate is of tempered Beryllium copper to provide a simple azimuth adjustment. The winding is centre tapped to give the option of presenting a lower impedance to bias and signal sources during recording.

BY

MARRIOTT MAGNETICS LTD.

Waterside Works, Ponsharden, Penryn, Cornwall. Phone Penryn 3591/3363. London Office: Phone Wembley 7493

SPECIALISTS IN ALL TYPES OF HEADS FROM THE ECONOMY MASS-PRODUCED ARTICLE TO THE VERY HIGH QUALITY PROFESSIONAL HEAD FOR SOUND RECORDERS AND COMPUTERS. OUR TECHNICAL KNOWLEDGE MAKES IT POSSIBLE TO DEVISE, PLAN AND PRODUCE THE MOST VERSATILE RANGE OF HEADS IN BRITAIN—FOR EITHER TAILOR-MADE OR MASS-PRODUCED DEVICES IN ALL DIVISIONS OF RECORDING.

WW—035 FOR FURTHER DETAILS

YOU WANT PARTS URGENTLY

—almost immediately!

So what do you do?

You reach for the 'phone and dial ONO 239 8072, if it is anything made by the United-Carr Group. You will be surprised how soon you'll get what you want.

Your immediate needs are our business

We exist to supply the small user quickly with *standard* parts made by these Companies and carry large stocks of their fasteners and clips and a wide range of Radio, Electronic and Electrical components. We're geared to speedy handling and dispatch.

But you will need our latest catalogue

For quick and accurate ordering you should keep our comprehensive catalogue by you. This useful reference book gives full details of the wide range of parts we stock—nearly everything of the kind that you are likely to require.

Even though not ordering anything immediately, you should write now for this useful publication and so be ready to handle rush jobs whenever they arise.

United-Carr Supplies Ltd.,
Frederick Road, Stapleford, Nottingham.
Sandiacre 8072 STD ONO 239 8072

Cinch DOT FT STOCKISTS

UNITED-CARR SUPPLIES

UNITED-CARR GROUP

WW—036 FOR FURTHER DETAILS

Valradio TRANSVERTERS

(TRANSISTORISED D.C. CONVERTERS/INVERTERS)

TYPE BI2/200S

PRICE £67-12-0

INTRODUCING THE VALRADIO "B" SERIES
SINEWAVE output 200W (120W also available)
FREQUENCY: 50 c/s±¼ c/s (60 c/s to order).
OUTPUT V.: 115-230v.±10%.
INPUT V.: 12v.—10%+25% (24-50v. also available).

★ FREQUENCY REGULATION OF ± .005% WITH ADDITIONAL "RESONATOR".
★ INFINITE LIFE
★ WILL OPERATE ALMOST ANY ELECTRONIC OR ELECTRICAL EQUIPMENT.
★ SUITABLE FOR SUPER-SENSITIVE RADIO & AUDIO EQUIPMENT.

OTHER MODELS from £10/to £179/12/-. 12v. to 110v. D.C. up to 1kW

VALRADIO LTD., Dept. C10

BROWELLS LANE · FELTHAM · MIDDLESEX · ENGLAND
Telephone: FELTHAM 4837-4242 01-890-4837/4242

VALRADIO and STEREOSONOSCOPE are the registered trade marks of VALRADIO LTD.

WW—037 FOR FURTHER DETAILS

HOWELLS RADIO LTD.

MINISTRY OF AVIATION INSPECTION APPROVED

TRANSFORMERS
STANDARD RANGE OR DESIGNED TO YOUR SPECIFICATION
0-50KVA, "C" CORE, PULSE, 3 PHASE, 6 PHASE, TOROIDS, ETC.
Transformers for 20W Transistor Amplifier (W.W., Nov. 1966).

Driver	22/6	Carr.	2/-
Mains	25/6	Carr.	4/6

L.P. Filter, Chassis Mounting 11/6. Carr. 1/-.
L.P. Filter, Printed Circuit Mounting 14/6. Carr. 1/-.

*MAINS TRANSFORMERS
350-0-350 v. 60 mA., 6.3 v. 2 A. £1/15/-. Carr. 4/6.
500 v. 300 mA. 6.3 v. 4 A., 6.3 v. 1 A. £3/12/6. Carr. 5/6
500-0-500 v. 0.25 A., 6.3 v. 4 Act., 6.3 v. 3 Act., 5 v. 3 A. £4/10/6. Carr. 6/6.
525-0-525 v. 0.5 A., 6.3 v., 6 Act., 6.3 v., 6 Act., 5 v. 6 A. £5/5/-. Carr. 6/6.

*LOW VOLTAGE

30-0-30 v. 4 A.	£2/5/6. Carr. 5/6.
15 v. 2 A.	£1/12/6. Carr. 3/-.
15 v. 6 A.	£2/1/-. Carr. 4/6.
15 v. 10 A.	£2/15/-. Carr. 5/6.

STEP DOWN TRANSFORMER
Primary 0-415-440 v. Sec. 250 v. 1.5 A. £5/5/-. Carr. 6/6.
*PRIMARIES 10-0-200-220-240 v.

CHASSIS, CABINETS & PRECISION METALWORK

ELECTRONICS—DEVELOPMENT & ASSEMBLY

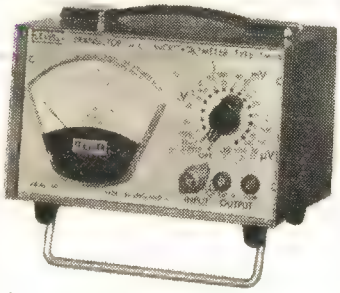
CASH WITH ORDERS PLEASE
Carlton Street, Manchester 14, Lancashire
TEL. (STD 061) 226-3411

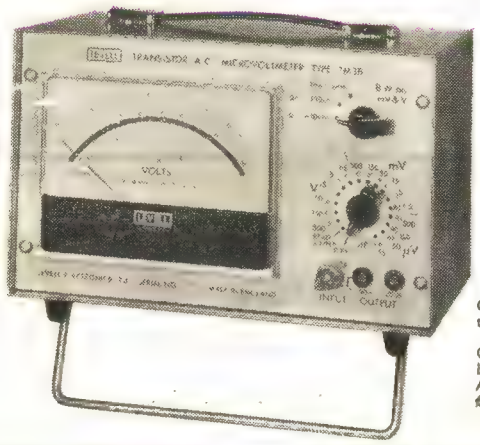
WW—038 FOR FURTHER DETAILS

LEVELL VOLTMETERS measure μV's from 1Hz to 450MHz

TRANSISTOR A.C. MICROVOLTMETERS

Response from 1Hz to 3MHz with amplifier output available. Two versions differ only in meter size and bandwidth switch on type TM3B.





TYPE TM3A
£49

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather case £4/10/-.
A.C. Power Unit £7/10/-.

TYPE TM3B
£63

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather Case £5.
A.C. Power Unit £7/10/-.

VOLTMETER RANGES
15μV, 50μV, 150μV . . . . 500V f.s.d.
Accuracy ±1% ±1% f.s.d. ±1μV at 1kHz.

dB RANGES
−100dB to +50dB in 10dB steps. Scale −20dB to +6dB. 0dB = 1mW into 600Ω.

FREQUENCY RESPONSE
Above 500μV: −3dB from 1Hz to 3MHz. 0·3dB from 4Hz to 1MHz.
On 500μV: ±3dB from 2Hz to 2MHz.
On 150μV: ±3dB from 4Hz to 1MHz.
On 50μV: ±3dB from 7Hz to 500kHz.
On 15μV: ±3dB from 20Hz to 200kHz.

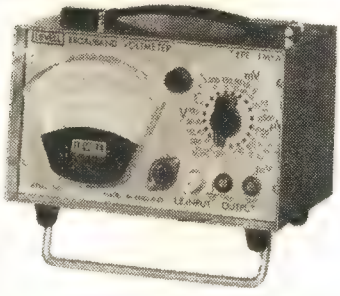
AMPLIFIER OUTPUT
150mV at f.s.d. on all ranges. Will drive a load of 200kΩ and 50pF without loss.

POWER SUPPLY
One type PP9 battery, life 1000 hours; or, A.C. mains when Power Unit fitted.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

BROADBAND VOLTMETERS

As A.C. Microvoltmeters plus H.F. probe to extend response to 450MHz. Two versions differ only in meter size and L.F. bandwidth switch on type TM6B.



TYPE TM6A
£85

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather Case £4/10/-.
A.C. Power Unit £7/10/-.

TYPE TM6B
£99

Complete with battery and input lead.

OPTIONAL EXTRAS
Leather Case £5.
A.C. Power Unit £7/10/-.

H.F. VOLTAGE RANGES
1mV, 3mV, 10mV . . . . 3V f.s.d. Square law scales. Accuracy ±4% of reading ±1% of f.s.d. at 30MHz.

H.F. dB RANGES
−50dB, −40dB, −30dB . . . . +20dB. Scale −10dB to +3dB. 0dB = 1mW into 50Ω.

H.F. RESPONSE
±0·7dB from 1MHz to 50MHz.
±3dB from 300kHz to 400MHz.
±6dB from 400MHz to 450MHz.

L.F. RANGES
As TM3A and TM3B except for the omission of 15μV and 150μV.

POWER SUPPLY
One type PP9 battery, life 1000 hours on L.F. ranges and 400 hours on H.F. ranges; or, A.C. mains when Levell Power Unit is fitted

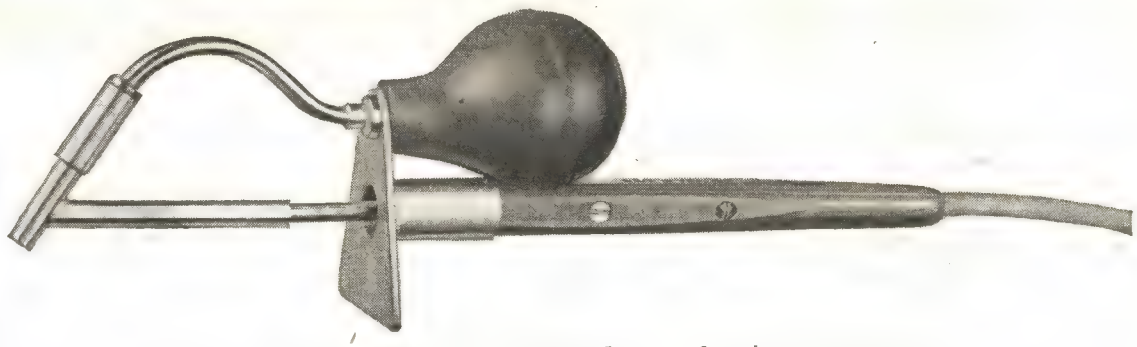
Fully detailed leaflets are available on our complete range of portable instruments.

LEVELL
PORTABLE INSTRUMENTS

WW—039 FOR FURTHER DETAILS

LEVELL ELECTRONICS LTD., Park Road, High Barnet, Herts. Tel.: 01-449 5028

THE Addamin DE-SOLDERING TOOL



- Self-contained—does NOT require the use of air-lines or pumps
- Simple, light and inexpensive
- PERMABIT nozzle will not wear or become eroded by the solder
- Standard nozzle $\frac{5}{64}$ in. bore. Alternative, $\frac{3}{64}$ in. bore
- Mains or low voltages

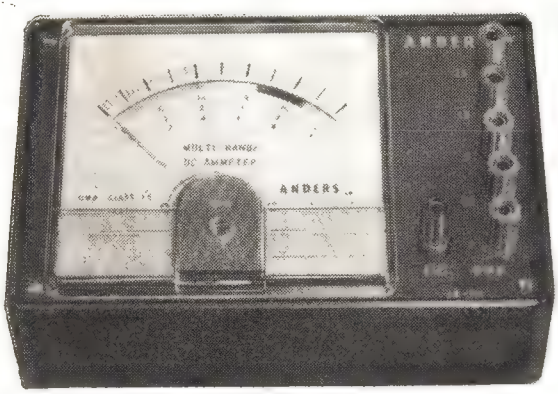
Literature on request

LIGHT SOLDERING DEVELOPMENTS LTD 28 Sydenham Road, Croydon, CR9 2LL

Telephone: 01-688 8589 & 4559

WW—040 FOR FURTHER DETAILS

A NEW RANGE OF SINGLE-FUNCTION PORTABLE METERS AT REALISTIC PRICES



Produced, to Anders' specification, by a leading overseas manufacturer. D.C. accuracies within 1.5% F.S.D. A.C. accuracies within 2.5% F.S.D. Mirror scale approx. 3.5" Case dimensions $7\frac{1}{4}$" x $4\frac{1}{4}$" x 3". Dual connection terminals. Supplied complete with robust leads. Models marked with an asterisk have varistor protection against 50% overload.

*SM-301. DC MICROAMMETERS, with range selection by rotary switch.
RANGES: 50, 100, 250, 500 and 1,000 Microamperes. **£9.2.6** *nett*

*SM-311. DC MILLIAMMETERS, with range selection by rotary switch.
RANGES: 1, 5, 10, 25, 100, 250, 500 and 1,000 Milliamperes. **£8.0.0** *nett*

SM-321. DC AMMETER, with range selection by terminals.
RANGES: 1, 2.5, 5, 10 and 25 Amperes. **£8.0.0** *nett*

*SM-331. DC VOLTMETER, with range selection by rotary switch.
RANGES: 1, 2.5, 5, 10, 25 50, 100, 250, 500 and 1,000 Volts.
SENSITIVITY: 20,000 Ohms per Volt. **£9.15.0** *nett*

*SM-351. AC MILLIAMMETER, with range selection by rotary switch.
RANGES: 5, 25, 100, 250 and 1,000 Milliamperes. **£8.10.0** *nett*

SM-361. AC AMMETER, with range selection by terminals, incorporating Current Transformer.
RANGES: 1, 2.5 5, 10 and 25 Amperes. **£9.15.0** *nett*

*SM-371. AC VOLTMETER, with range selection by rotary switch.
RANGES: 5, 10, 25 50, 100, 250, 500 and 1,000 Volts.
SENSITIVITY: 2,000 Ohms per Volt. **£8.15.0** *nett*

ANDERS ELECTRONICS LIMITED · 103 Hampstead Road · London NW1 · Telephone: Euston 1639

WW—041 FOR FURTHER DETAILS

with the rugged **PROVED** reliability of the

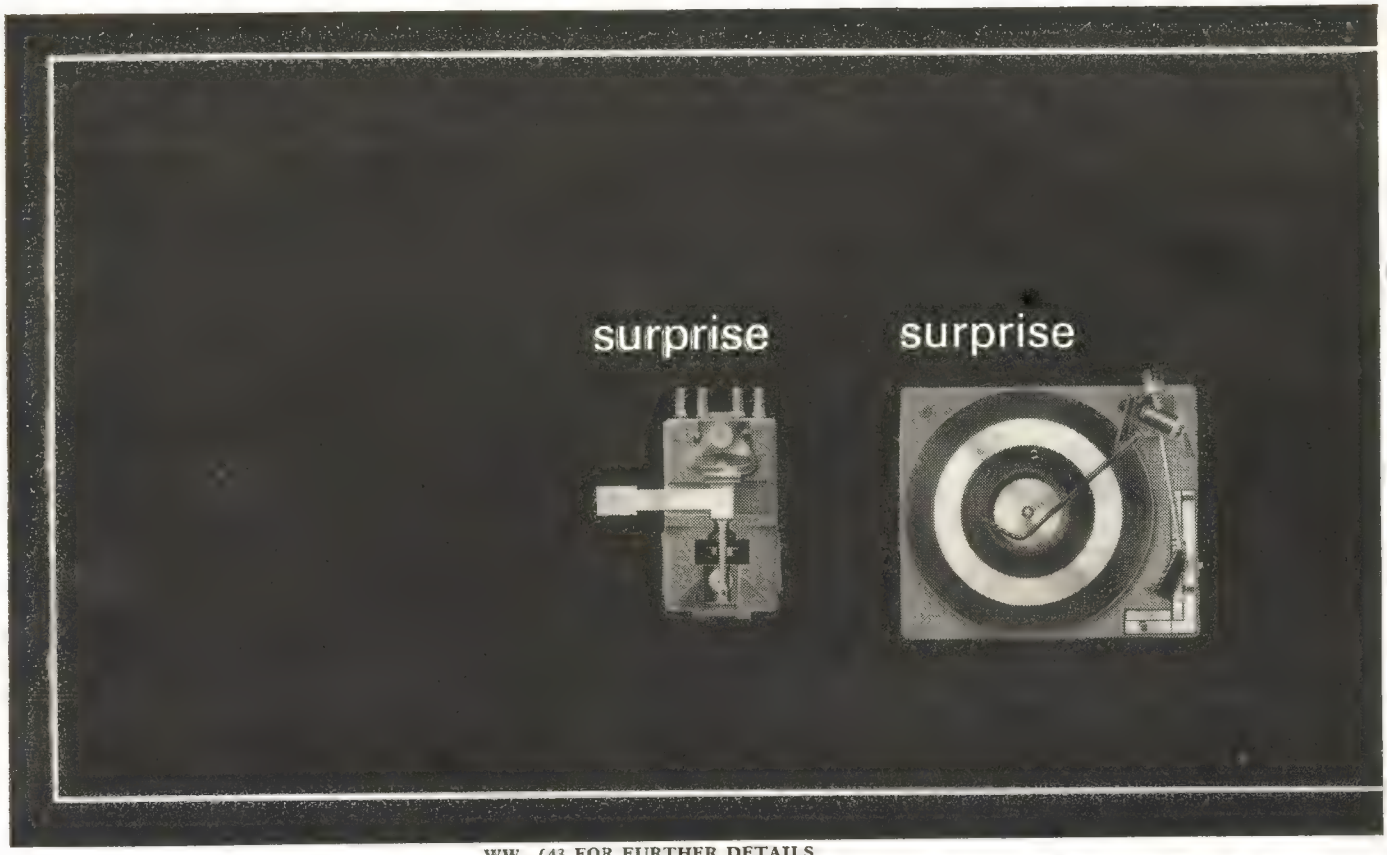
PYE 'VANGUARD' mobile radio

☐ Up to 100W r.f. output ☐ All-transistor receiver with low current consumption on stand-by ☐ Up to 4W audio output ☐ G.P.O. approved; meets U.S., Canadian and European specifications ☐ Sealed I.F. block fitters ☐ A.M. or F.M. versions ☐ Dust and splash-proof ☐ Option of 12½ kc/s, 20/25/30 kc/s or 40/50/60 kc/s channel spacing ☐ 1 to 10 channels available

Pye Telecommunications Limited, Cambridge, England
Telephone Cambridge 61222. Telex 81166

WW—042 FOR FURTHER DETAILS

MR 14



WW—043 FOR FURTHER DETAILS

OVER 30% OFF

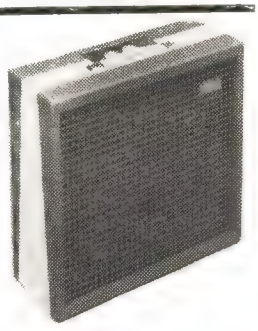
SUPERB FULL FREQUENCY

Bird AMPLIFIERS

DUE TO EXCESS PRODUCTION

Normally 18 gns. **NOW 12 GNS.**

- ★ 5 Watts undistorted output.
- ★ 10in. elliptical "Elac" speakers.
- ★ Separate variable controls for tone and volume.
- ★ Cabinet immaculately finished in leathercloth.
- ★ Full maker's guarantee.



IMMEDIATE DELIVERY

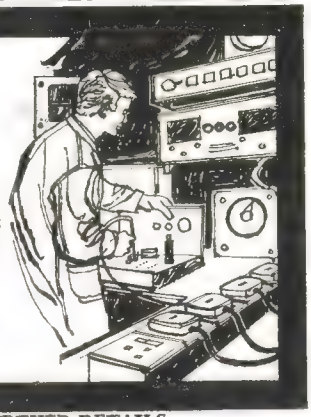
Cash with order MUSIC DEN, DEPT. W.W., ALDER ROAD, PARKSTONE, POOLE.

WW—044 FOR FURTHER DETAILS

Your choice of Live Sockets - Instantly!

A Lexor DIS-BOARD gives you up to 6 sockets from one power outlet. Portable or permanent fixing, compact units, with safety neon. Over 1,000 socket combinations available from stock. All types of fittings and finishes.

brochure from
LEXOR DIS-BOARDS LIMITED,
Allesley Old Road, Coventry.
Telephone 72614 or 72207



WW—045 FOR FURTHER DETAILS

WHERE THE GOING IS TOUGH, THE NEED FOR QUALITY VITAL GOVERNMENTS AGREE ON TEONEX VALVES.

Governments all over the world have chosen TEONEX Valves for vital civil and military roles requiring compliance to E.V.S. or M.I.L. standards. In spite of rising demand for these valves from government departments the world over, increased production facilities have made it possible to offer the TEONEX range (incorporating the entire range of British-produced valves or their Continental equivalents) for use outside the U.K. only.
Price list and technical specifications may be obtained from:—

Export Enquiries Only Please!

TEONEX LIMITED
2a Westbourne Grove Mews,
London, W.11, England

REGD. TRADE MARK
TEONEX

WW—046 FOR FURTHER DETAILS

Perhaps you will be as surprised as the pundits when you hear the facts* about the BSR C1 ceramic cartridge ". . . another milestone on the public right-of-way to high fidelity"—said *The Gramophone.*

You could even be surprised to know that the BSR UA70 manual/automatic turntable unit is fitted with such a splendid cartridge and that its all round performance is equal to such high standards.

But maybe not . . . you could be one of those sensible people who knew all along that BSR don't just make a lot of autochangers but a lot of *very good* autochangers.

If you'd like to read the independent test reports write to Arthur Nicholls at:

BSR Limited,
Monarch Works, Cradley Heath, Warley, Worcs.

for better sound reproduction

BSR UA70 SPECIFICATION

Turntable
Wow ..... Less than ·2%
Flutter ..... Less than ·06%
Long term speed variation
Less than ·5%
(mains voltage ± 10%)
Rumble (ref.1kHz) —29 dB

Pick-up arm
Counterbalanced lightweight arm with calibrated tracking pressure control, integral cueing device and automatic lock.
Tracking pressure (depending on cartridge) 2 grams. min.

Cartridge
The now famous C1 ceramic
Compliance $5{\cdot}2 \times 10^{-6}$ cm/dynes
Frequency response 20-15,000 Hz ± 2dB

Standard UA70 player £12.18.3*
C1 Ceramic Cartridge
sapphire stylus £2. 7.0*
diamond stylus £3. 1.9*
*Inc. P.T. surcharge

WW—047 FOR FURTHER DETAILS

CHASSIS and CASES

by Smith's of EDGWARE ROAD

H. L. SMITH & CO. LTD.
Electronic Components · Audio Equipment
287/289 EDGWARE ROAD, LONDON, W.2.
Tel: 01-723 5891
We shall be pleased to quote for all your component requirements.

BLANK CHASSIS

SAME DAY SERVICE

Of over 20 different forms made up to **YOUR SIZE.** (Maximum length 35in., depth 4in.)

SEND FOR ILLUSTRATED LEAFLETS

or order straight away, working out total area of material required and referring to table below, which is for four-sided chassis in 16 s.w.g. aluminium.

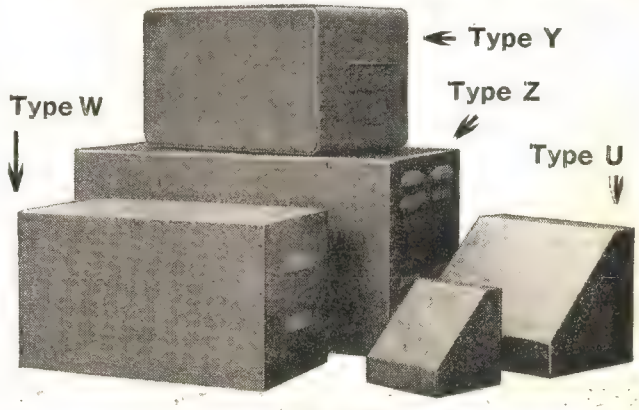
48 sq. in.	4/6	176 sq. in.	9/10	304 sq. in.	15/2
80 sq. in.	5/10	208 sq. in.	11/2	336 sq. in.	16/6
112 sq. in.	7/2	240 sq. in.	12/6	368 sq. in.	17/10
144 sq. in.	8/6	272 sq. in	13/10	and pro rata.	
P. & P. 2/6.		P. & P. 3/-.		P. & P. 4/6.	

Discounts for quantities. More than 20 sizes kept in stock for callers.

FLANGES (¼in., ⅜in.). 6d. per bend.

STRENGTHENED CORNERS 1/- each corner.

PANELS: Any size up to 3ft. at 6/- sq. ft. 16 s.w.g. (18 s.w.g 5/3). Plus post and packing.



CASES

ALUMINIUM, SILVER HAMMERED FINISH

Type	Size	Price	Type	Size	Price
U	4 × 4 × 4*	10/-	Y	8 × 6 × 6*	26/6
U	5½ × 4½ × 4½	15/6	Y	12 × 7 × 7	41/-
U	8 × 6 × 6	21/-	Y	13 × 7 × 9	46/-
U	9¼ × 7½ × 3½	22/-	Y	15 × 9 × 7	48/6
U	15 × 9 × 9	44/6	Z	17 × 10 × 9.....	66/-
W	8 × 6 × 6	21/-	Z	19 × 10 × 8½	71/-
W	12 × 7 × 7	34/-	*Height		
W	15 × 9 × 8	44/-			

Plus post and packing.

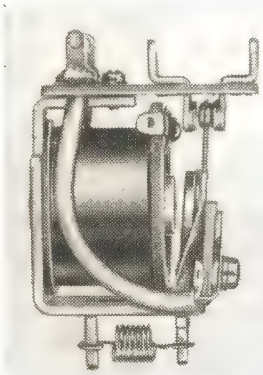
Type U has removable bottom or back, Type W removable front, Type Y all-screwed construction, Type Z removable back and front.

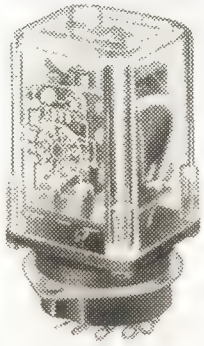
WW—048 FOR FURTHER DETAILS

LITTLE KING
MINI-POWER RELAYS

DELIVERED IMMEDIATELY

EX STOCK

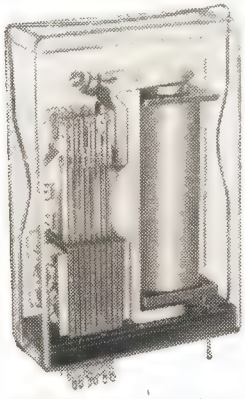




Screw-Fix type, 2, 3 & 4 pole. Quick-change plug-in type 2 & 3 pole, 12 & 24 VDC, 100 & 240 VAC. Ex Stock: others on quick delivery.
Little space required: Screw-Fix 1.7 sq. in., Quick-Change 2.0 sq. in. **King** size switching: Screw-Fix 2 KVA, Quick-Change 1.5 KVA. 10 million operations (proof tested on 27 million).

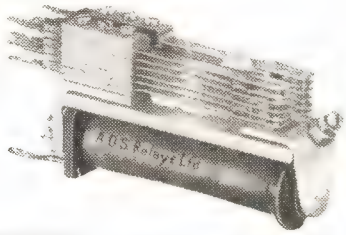
3000 TYPE RELAYS EX STOCK

Ex Stock specially manufactured to meet general purpose requirements, or to your specifications in 14-28 days.



PI Plug-in 3000 Type (Illustrated)
Plug-in version of 3000 and K3000 series:—Coils and contacts to G.P.O./R.C.S. and variations: Standard contact insulation is 250V working: 400/750V also provided: Bases available ex-stock for immediate production: Relays changed in seconds avoiding stoppages. Approx. dimensions: 4⅛in. x 3in. x 1⅝in.

600 and K600 series
Miniaturised 3000 Type with similar but restricted specification: Requires only ¾in. chassis space (twelve in same length as nine 3000 Type): 1 or 2 coils: 1 to 6 contact units (14 springs max.).



APPROVED BY E.I.D., A.R.B., C.E.G.B., ADMIRALTY, ETC.

A.D.S. RELAYS LTD.
97, ST. JOHN STREET, LONDON, E.C.1.
Telephone: 01-253 3393

WW—049 FOR FURTHER DETAILS

VARIABLE—HIGH CURRENT SMOOTHED POWER SUPPLIES WITH ACCUMULATOR PERFORMANCE FROM A.C. MAINS

TYPES
250VRU/30/20
250VRU/60/10
250VRU/120/5
250VRU/240/2.5

PRICE : £131.5.0

FEATURES. Type 250VRU 30/20. 0-30 v. Continuously Variable up to 20A.

RIPPLE CONTENT. Negligible. IMPEDANCE and REGULATION equivalent to accumulator performance. SILICON RECTIFIERS. Inadvertent "SHORT" protection.

OVERLOAD CAPACITY. 200% for short periods. Supplied to M.O.Tech for servicing 28 v. aircraft instrumentation within B.C.A.R.'s. Ref.10K CA3035. Suitable for "19" RACKMOUNTING.

FIXED OUTPUTS. ALSO AVAILABLE. Smoothed 12 or 24 v. up to 24A.

APPLICATIONS OPERATING AND SERVICING. Transistorised equipment e.g. 12-24 v. Mobile Radio Telephone. D.C. motors, etc., direct from AC—WITHOUT THE USE OF ACCUMULATORS.
AVOID THE EXTRA EXPENSE OF SUPER REGULATION YOU MAY NEVER NEED.

PRICES: £14.16.0 to £88.4.0.

Please write to Department C3b for current literature.

Valradio LIMITED

BROWELLS LANE, FELTHAM, MIDDLESEX, ENGLAND.

Tel.: FELTHAM 4837-4242. 01-890-4837/4242

VALRADIO and STEREOSONOSCOPE are the registered trade marks of VALRADIO LIMITED.

WW—050 FOR FURTHER DETAILS

TRANSFORMERS
COILS
CHOKES

LARGE OR SMALL QUANTITIES
TRADE ENQUIRIES WELCOMED

SPECIALISTS IN
FINE WIRE WINDINGS
MINIATURE TRANSFORMERS
RELAY AND INSTRUMENT COILS, ETC.
VACUUM IMPREGNATION TO APPROVED STANDARDS

ELECTRO-WINDS LTD.
CONTRACTORS TO G.P.O., A.W.R.E., L.E.B., B.B.C., ETC.
123 PARCHMORE ROAD, THORNTON HEATH, SURREY
01.653.2261 CR4.8LZ EST. 1933

WW—051 FOR FURTHER DETAILS

TWO BENTRON TRIACS
BTR403 (400V, 3A) BTR406 (400V, 6A)

Silicon bi-directional triode thyristors for A.C. phase control and general A.C. switching applications.

Peak Forward Blocking Voltage	400V
Peak Gate Current at 75°C	500mA
Peak Gate Power at 75°C	5W
Maximum Gate Current to Fire	50mA
Maximum Gate Voltage to Fire	3V
TO-66 Can	

PRICES

	BTR403	BTR406
1-24:	26/-	48/-
25 up:	22/-	26/-

Available ex-stock

Full data sheets sent on request

RASTRA Electronics Ltd.,
275/281 King Street, London, W.6. Tel: RIV 2960

WW—052 FOR FURTHER DETAILS

Thorn Special Products Ltd — among the leading manufacturers and suppliers of high quality components for the professional, electrical, electronic and aircraft industries — offer the widest range of products plus a complete service in instrument panel lighting. Technical literature is freely available.

Thorn Special Products Ltd

GREAT CAMBRIDGE ROAD, ENFIELD, MIDDX. ENFIELD 5353

a member of the Thorn Electrical Industries Ltd group of companies

High Quality Components for the Professional User

WW—053 FOR FURTHER DETAILS

B

TECHNICAL TRAINING
in radio television and electronics

Whether you are a newcomer to radio and electronics, or are engaged in the industry and wish to prepare for a recognized examination, ICS can further your technical knowledge and provide the specialized training so essential to success. ICS have helped thousands of ambitious men to move up into higher paid jobs—they can help you too! Why not fill in the coupon below and find out how?

Many diploma and examination courses available, including expert coaching for:

- **Institution of Electronics & Radio Engineers (Brit.I.R.E.)**
- **C. & G. Telecommunications Techns. Certs.**
- **C. & G. Supplementary Studies**
- **R.T.E.B. Radio/T.V. Servicing Certificate**
- **Radio Amateurs Examination**
- **P.M.G. Certs. in Radiotelegraphy**
- **General Certificate of Education, etc.**

Examination Students coached until successful

NEW SELF-BUILD RADIO COURSES

Learn as you build. You can learn both the theory and practice of valve and transistor circuits, and servicing work while building your own 5-valve receiver, transistor portable, signal generator and multi-test meter—all under expert tuition. Transistor Portable available as separate course.

POST THIS COUPON TODAY

for full details of ICS courses in Radio, T.V. and Electronics.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. 227, Intertext House, Parkgate Road, London, S.W.11

Please send me the ICS prospectus—free and without obligation

(state Subject or Exam.).....

.....

NAME.....

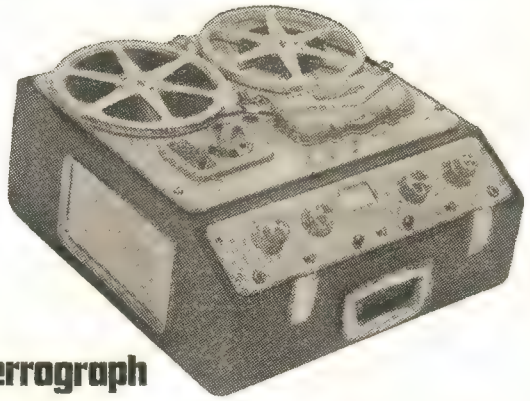
ADDRESS.....

..... 967

INTERNATIONAL CORRESPONDENCE SCHOOLS

WW—054 FOR FURTHER DETAILS

What have the happiest Hi-Fi enthusiasts in common with the Fire, Police and Defence services...with theatrical producers and concert impressarios?



The Ferrograph

Ferrographs are unique in their combination of reliability, rugged construction and *fidelity of recording*... not for the first exciting months of ownership, but for year after year of faultless performance. Even so, we do not claim perfection, although we do believe that we have come nearest of all to the ideal. And the vast majority of Ferrograph users agree.

Complete and post the coupon—*you'll enjoy moving up into the Ferrograph class.*

Post this coupon to:
THE FERROGRAPH COMPANY LIMITED
84 Blackfriars Road, London, S.E.1.

Please send me the FREE illustrated Ferrograph leaflet.

Please send the comprehensive 64-page Ferrograph Manual for which I enclose £1—refundable when I purchase my Ferrograph.

Mono.....Stereo.....(Tick items required):

Name.....

Address.....

.....

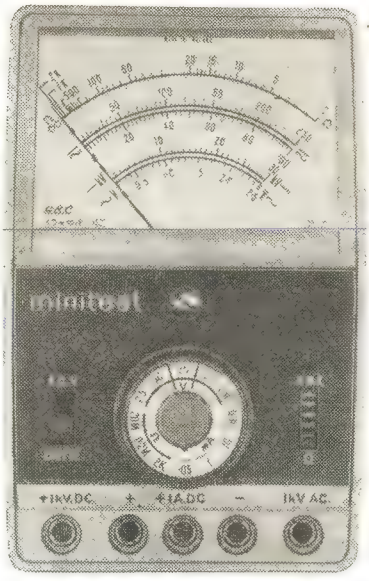
WW14

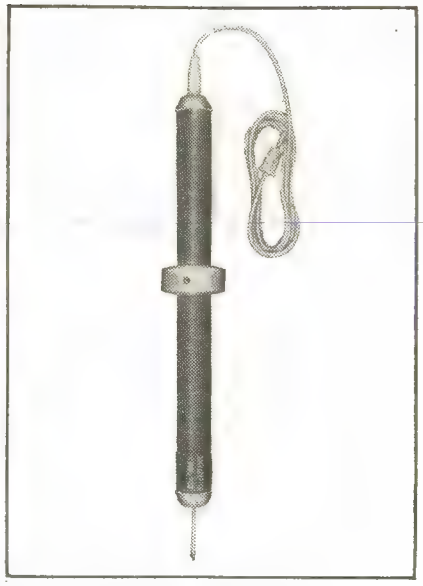
Ferrograph

THE INCOMPARABLE TAPE RECORDER

WW—055 FOR FURTHER DETAILS

*a special scale minitest can now be used with the high voltage probes for servicing black and white and colour T V sets





Special scale minitest

- ☐ D.C. sensitivity 20,000 ohms per volt.
- ☐ A.C. sensitivity 2,000 ohms per volt.
- ☐ Small size, 5¾″ x 3¾″ x 2⅛″.
- ☐ Weight 18 ozs.
- ☐ D.C. accuracy = 2½% F.S.D.
- ☐ A.C. accuracy = 2¾% F.S.D.
- ☐ A.C. accuracy maintained up to 20kc/s. 20 ranges.

All the standard Minitest features at the same price of **£7·17·6** Trade Price

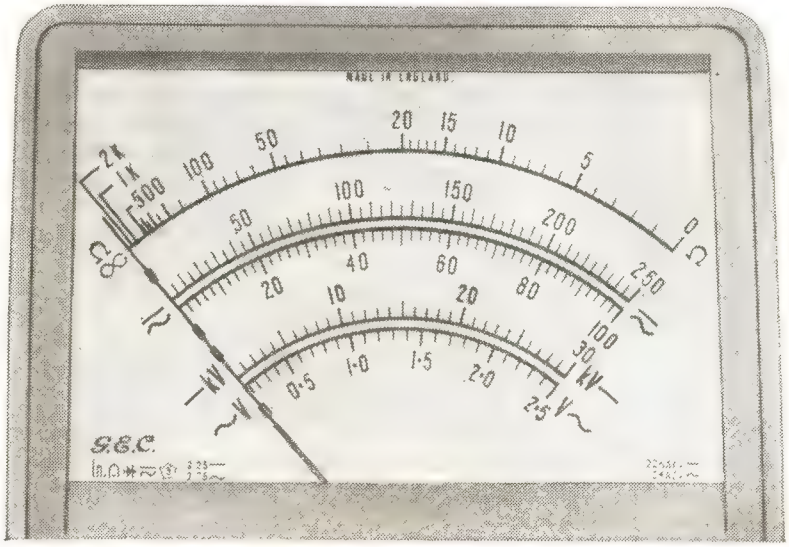
High voltage probes

Two high voltage probes are now available which extend the range of the Minitest to 25 KV or 30 KV direct current, for the measurement of E.H.T. voltages on T.V. sets and similar electronic equipment with a high source impedance. Lead 36″ long with 4 mm plug.

Price each **£5·3·0** Leaflets on request.

SEI Salford Electrical Instruments Limited G.E.C.
Peel Works, Barton Lane, Eccles, Manchester. Telephone ECCles 5081. Telex 66711.
London Sales Office: Brook Green, Hammersmith, W6. Tel 01-603 9292 A Subsidiary of The General Electric Co. Ltd. of England.

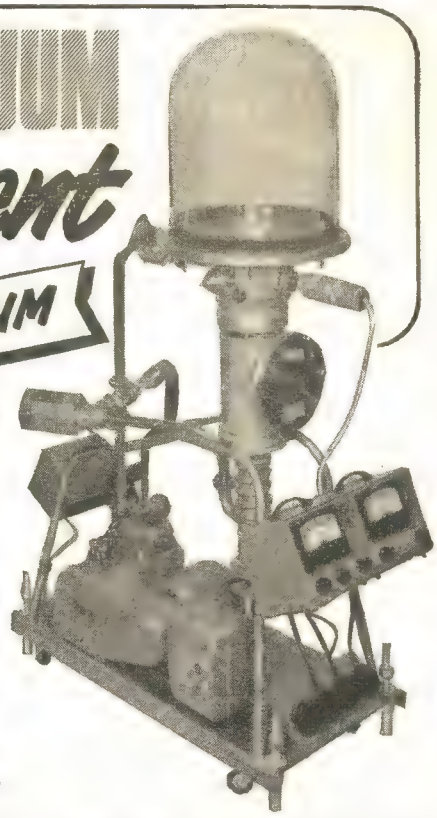
the well-known Salford minitest is now available with a special 30 KV scale*



WW—056 FOR FURTHER DETAILS

GeneVac HIGH VACUUM Equipment

FOR THE MANUFACTURE OF HIGH VACUUM



- ★ Pumping Equipment and Accessories
- ★ Evaporation & Freeze Drying Plant
- ★ Instrumentation & Control Equipment
- ★ Custom Built Plant & Engineering
- ★ All utilizing Vaclok-Intervac Pipeline System

For full information and Data Sheets apply

GENERAL

GENERAL ENGINEERING CO. (RADCLIFFE) LTD.

STATION WORKS, BURY ROAD, RADCLIFFE, MANCHESTER. Tel.: RADcliffe 3041-5 STD.061

1966 THE QUEEN'S AWARD TO INDUSTRY

Regional Offices:—
LONDON Tel. (STD.01) 643 4541-5
MIDLAND Tel. Shirley 4508
SCOTTISH OFFICE: Tel. Caledonian 5597

WW—057 FOR FURTHER DETAILS

LINEAR

NEW RANGE OF SOLID STATE A.C. MAINS AMPLIFIERS

Employing only high grade components and transistors

If required an attractive wood cabinet with Satin Teak veneer finish can be supplied for any model. Prices from **£3-10-0**

LT55 6 WATT AMPLIFIER

A High Fidelity unit providing excellent results at modest output levels.

Frequency Response 30-20,000 cps—2dB
Sensitivity 5 mv (max)
Harmonic Distortion 0.5% at 1,000 cps.
Output for 3-8-15 ohm Loudspeakers.
Input Sockets for 'Mike,' Gram and Radio Tuner/Tape Recorder.

Recommended Retail price 8 GNS
Size 9½ × 2¾ × 5¼in.
Controls (5) Volume, Bass, Treble, Mains Switch, Input Selector Switch.

LTA15 15 WATT AMPLIFIER

High Fidelity Output switched inputs for Gram, 'Mike,' Tape, and Radio.

Frequency Response 10-40,000 cps—3dB
Bass Control +18dB to −16dB at 40 cps
Treble Control +17dB to −14dB at 14 Kcs
Hum and Noise −80dB
Harmonic Distortion 0.2% at rated output.

Recommended Retail price 16 GNS
Size 9½ × 3¾ × 5¼in.
Output for 3-8-15 ohm Loudspeakers.

LT66 12 WATT STEREO AMPLIFIER

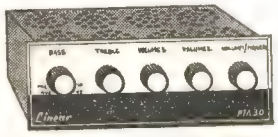
A twin channel version of the LT55 providing up to 6 watts High Fidelity output on each channel.

Switched Input Facilities Socket (1) Tape or crystal PU (2) Radio Tuner (3) Ceramic PU Microphone
Controls (6) Volume, Bass, Treble, Balance, Mains Switch, Input Selector Switch. Stereo/Mono Switch
Facia Plate Rigid Perspex with black/silver background and matching black edged knobs with spun silver centres.

Recommended Retail price 15 GNS
Size 12 × 3½ × 6in.

PTA30 HI-FI PUBLIC ADDRESS AMPLIFIER

A successor to our popular Conchord 30 watt unit.



Input Sensitivity 2 mv (max)
- ★ Output 30 watts.
- ★ Output Terminals or Loudspeaker or combination of Speakers with total impedance between 3 ohms and 30 ohms.
- ★ Three individually controlled Jack Inputs for mixing purposes.

Housed in fully enclosed stove enamelled steel case.
Controls Vol (1) Vol (2) Vol (3) with mains switch, Treble 'lift' and 'cut'. Bass 'lift' and 'cut.'

Recommended Retail price 20 GNS
Size 12 × 3½ × 6in.

AN IDEAL UNIT FOR VOCAL AND INSTRUMENTAL GROUPS SUITABLE FOR ANY KIND OF 'MIKE' AND INSTRUMENT PICK-UP, ALSO FOR RADIO, TAPE OR GRAM.

Please send a stamped addressed envelope for full descriptive details of above units, also TUNER/AMPLIFIERS STEREO and MONO. **AVAILABLE FROM YOUR LOCAL HI-FI DEALER**

Wholesale and Retail enquiries to: **LINEAR PRODUCTS LTD., ELECTRON WORKS, ARMLEY, LEEDS**

WW—058 FOR FURTHER DETAILS

The Marine etc Broadcasting (Offences) Act 1967

How it may affect you

Pirate Radio Stations operating off our coasts may, of course, be said to broadcast the type of entertainment enjoyed by a large number of listeners.
On the other hand, they can, and do, cause serious interference with stations already operating on internationally agreed wavelengths, not only in this country but abroad. Protests have come from all over Europe. They may also jam ship's radio and interfere with distress signals, shipping forecasts, gale warnings and other essential messages.

Action by Parliament

To deal with this situation Parliament passed the Marine etc Broadcasting (Offences) Act, which came into force on August 15, 1967. The full provisions of the Act may be studied by applying for further information at Her Majesty's Stationery Office. The following is a condensation.

The Act

It is an offence under the Act to participate in any way in the activities of pirate radio stations or ships. Briefly:

Apparatus: (1) operating or assisting in the operation of the broadcast apparatus (2) carrying or agreeing to carry the broadcast apparatus in a ship, or (3) supplying, maintaining, installing or repairing the apparatus.

Supplying: Carrying people or goods to and from such stations or ships, provisioning (food, etc.), delivering any other item required or the engaging of crew.

Broadcasts: Taking part in any broadcast from pirate radio stations as an announcer or performer; or in any other capacity.

Advertising: Finally, it is illegal to *advertise by means of broadcasting from these stations, to create or supply any material (including scripts, tapes or other recordings) for such broadcasts; or to invite anyone else to do so.*

The Penalties

The maximum penalties for all these offences are the same: TWO YEARS imprisonment or a fine to be determined by the Court, or both.

The Popular Music Programme

None of this is to ignore the fact that there are audiences for all kinds of popular music. And the new service to be provided by the B.B.C. from 30th September, 1967, will, the Government believe, meet the needs of these audiences.

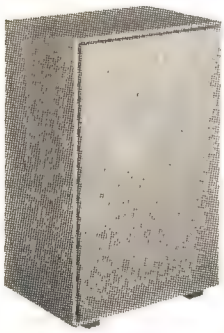
NEW·NEW·NEW
Stentorian
SPEAKER SYSTEMS

These superb new speaker systems make available even higher standards of performance in sound reproduction and uphold the high reputation gained by Whiteley Stentorian speakers throughout the world.

Attractively designed and soundly constructed, they are available in either Teak or Rosewood finish.

LC93
A 19″ × 12½″ × 8½″ completely enclosed acoustically loaded cabinet housing a 9″ graded melamine paper cone with siliconized cambric suspension giving a frequency response of 60Hz to 20KHz.

LC94
A 29½″ × 23¾″ × 6⅛″ acoustic Labyrinth enclosure fitted with acoustic resistance in the pipe, using the same highly efficient 9″ speaker unit used in the LC 93. Frequency response 45Hz to 20KHz.



LC95
The LC95 loudspeaker system is an acoustically loaded Bass Reflex cabinet, measuring 31½in. × 20¾in. × 13½in., fitted with two loudspeakers and a crossover network. The bass loudspeaker being used is a newly developed 12in. unit having a Melamine treated paper cone with a cambric surround. The middle and high frequency unit is a new 8in. loudspeaker having a Melamine treated paper ribbed cone and surround.

Send for full Technical Specifications on these outstanding new additions to the famous Stentorian Range.

WHITELEY ELECTRICAL RADIO COMPANY LTD
MANSFIELD · NOTTS · ENGLAND
Tel: Mansfield 24762
London Office: 109 Kingsway, W.C.2.
Tel: HOLborn 3074

WW—059 FOR FURTHER DETAILS

THERE'S A
TRANSIPACK®
STATIC INVERTER to suit you or NO BREAK POWER SUPPLY

BEST
- DESIGN
- PERFORMANCE
- DELIVERY

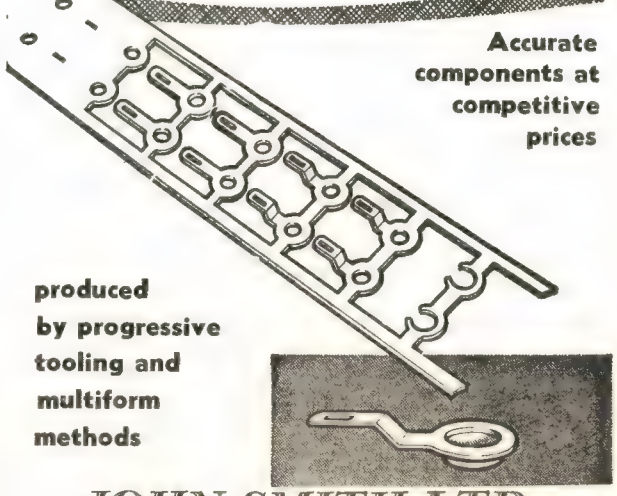
SINE AND SQUARE WAVE
—UP TO 80 K.V.A.—

INDUSTRIAL INSTRUMENTS LIMITED STANLEY RD., BROMLEY, KENT
Tel. 01-460 9212. Telegrams: Transipack, Bromley

WW—060 FOR FURTHER DETAILS

PRECISION PRESSINGS

Accurate components at competitive prices



produced by progressive tooling and multiform methods

JOHN SMITH LTD.
209 SPON LANE · WEST BROMWICH · STAFFS TELEPHONE: WES 2516 (3 lines)
WOODS LANE · CRADLEY HEATH · STAFFS TELEPHONE: CR 69283 (3 lines)

WW—061 FOR FURTHER DETAILS

WHAT'S THE

BIG NEW

PLUS

ON

FR HAMLIN

REED SWITCHES

SAME DAY SERVICE FROM

RTS

Please send for literature and full RTS catalogue.

RADIO & TELEVISION SERVICES LTD.

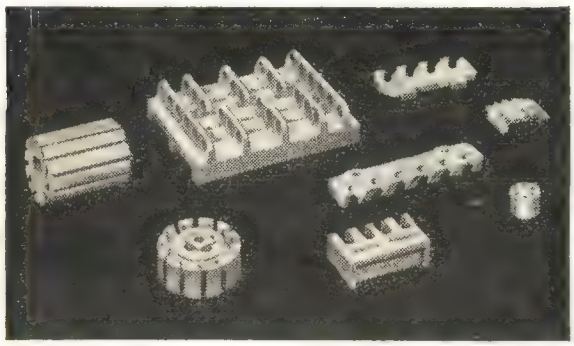
P.O. Box 11 · Gloucester St. Cambridge
Ring Cambridge 51471
direct line for spares orders.
Ring Cambridge 59101
for other business.
The STD prefix for Cambridge is 0CA3

WW—062 FOR FURTHER DETAILS

Bullers CERAMICS

for the **ELECTRONIC INDUSTRY**
(and Electrical Appliance Manufacture)

Frequelex—for high-frequency insulation.



Refractories for high-temperature insulation.

Bullers porcelain for general insulation purposes.

Meticulous care in manufacture, high quality material, with particular attention applied to *dimensional precision and accuracy*, explain the efficiency and ease of assembly when using Bullers die pressed products. *Write today for detailed particulars.*

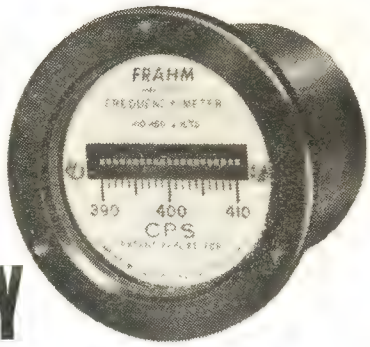
BULLERS LIMITED

Milton, Stoke-on-Trent, Staffs.

Phone: Stoke-on-Trent 54321 (5 lines
Telegrams & Cables: Bullers, Stoke-on-Trent
London Office: 6 Laurence Pountney Hill, E.C.4
Phone: MANsion House 9971

WW—063 FOR FURTHER DETAILS

FRAHM vibrating reed FREQUENCY METERS



are widely used as standards in many industries because:—

1) They are accurate (to ±0.3% or ±0.1.% as specified)
2) They are not voltage or temperature sensitive, within wide limits
3) They are unaffected by waveform errors, load, power factor or phase shift
4) They will operate on A.C., pulsating or interrupted D.C., and superimposed circuits
5) They need only low input power
6) They are compact and self-contained
7) They are rugged and dependable

FRAHM Vibrating Reed Frequency Meters are available in miniature, switchboard and portable forms, in ranges from 10 to 1700 cps. Descriptive literature on these meters, and on FRAHM Resonant Reed Tachometers, freely available from the sole U.K. distributors:—

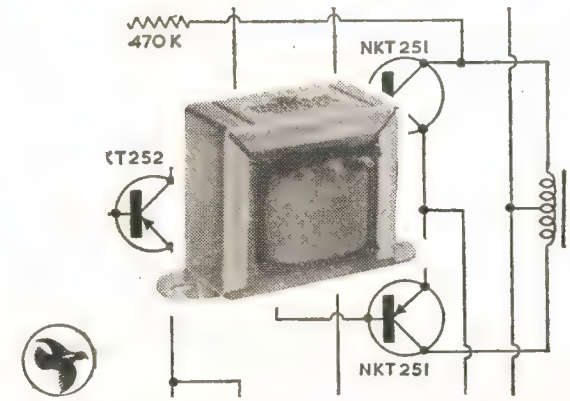
ANDERS METER SERVICE

ANDERS ELECTRONICS LTD. 103 HAMPSTEAD ROAD LONDON NW1
TELEPHONE EUSTON 1639 *MINISTRY OF AVIATION APPROVED*

WW—064 FOR FURTHER DETAILS

Partridge

believe in keeping up appearances



What we have in mind is the regularity with which Partridge Transformers are specified for almost every leading, published audio circuit. Proof of the high quality, superb performance and ultimate reliability which are the features of all Partridge Transformers.

Write and ask for details of the Partridge range of audio types now!

PARTRIDGE TRANSFORMERS LTD.

Roebuck Road, Chessington, Surrey. *Tel.: LOWer Hook 4353/4/5*

WW—065 FOR FURTHER DETAILS

SOUND SENSE

Broadcasting and recording studios throughout the world know that their efforts will be judged by millions of listeners and they take care that their own monitoring and listening rooms use the best equipment available. It is not surprising that the more discerning listeners use the same equipment in their own homes.

The new Listening and Demonstration Room of the BBC Transcription Service, fitted with QUAD 22 control unit, QUAD II power amplifiers and QUAD electrostatic loudspeakers.

QUAD

for the closest approach to the original sound.

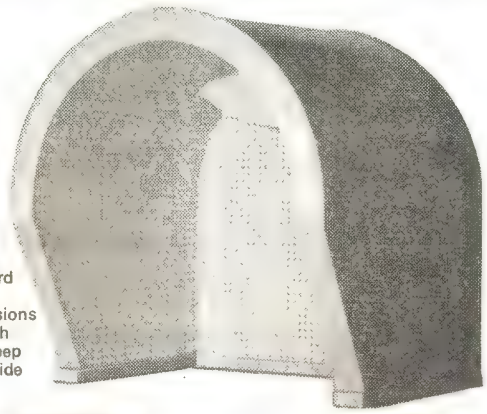
For full details of the QUAD range of units, send a postcard to:
Ref: WW. The Acoustical Manufacturing Co. Ltd. Huntingdon. Tel: 0480 2561/2

WW—066 FOR FURTHER DETAILS

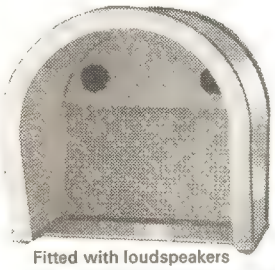
WHITELEY

for acoustic hoods

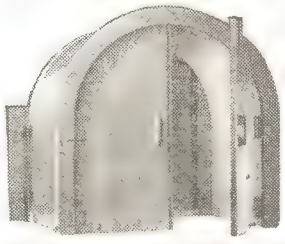
All noisy environments such as factories, workshops, department stores and hotels require the facility of an acoustic hood which permits telephone conversations to be held without the interference of annoying background noises. Whiteley acoustic hoods are strongly made from resin bonded ply and finished in a cellulose enamel which makes these suitable for indoor or outdoor use.



Standard Hood Dimensions
25″ high
20¼″ deep
24½″ wide



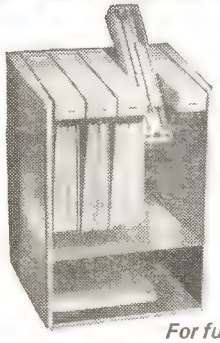
Fitted with loudspeakers



Fitted with doors for outdoor use

Also available with internal light and/or a storage shelf below hood

& directory holders



These attractive, and extremely functional directory holders will hold five directories neatly and securely, in individual swivel holders permitting easy identification and reference. The lower shelf provides additional storage space. The units are of cast alloy and are finished in an attractive grey epoxy resin enamel and constructed to strict G.P.O. design specifications.

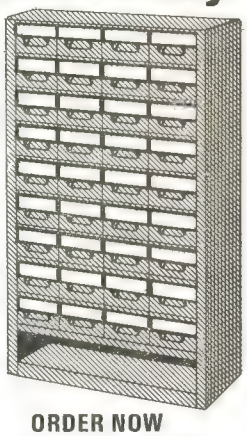
Directory Holder Dimensions
17¼″ high x 13½″ wide x 13⅜″ deep

For further details please write or telephone

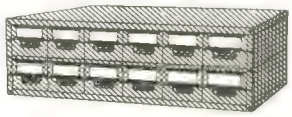
WHITELEY ELECTRICAL RADIO CO. LTD
MANSFIELD NOTTS ENGLAND Tel: Mansfield 24762
London Office: 109 KINGSWAY, W.C.2 Tel: HOLborn 3074

WW—067 FOR FURTHER DETAILS

Those transistors cost money! Protect them!!



36A SPACESAVER DRAWER UNIT 42″ high, 24½″ wide, 12″ deep. 36 drawers each 3″ high, 5¼″ wide, 10⅞″ deep, with identification cards.
(CARRIAGE FREE ON MAINLAND) **£12.0.0** BRAND NEW



12A POPULAR DRAWER UNIT 9″ high, 35″ wide, 12″ deep. 12 drawers each 3″ high, 5¼″ wide, 10⅞″ deep, with identification cards. Ideal for shelf or table-top.
£4.15.0 BRAND NEW

ORDER NOW
Send for FREE catalogue of our complete range of storage equipment.

N.C.BROWN LTD
INDUSTRIAL SALES DIVISION
pacesetters in storage equipment

Eagle Steelworks, Heywood, Lancs. Tel: 69018
London: 25/27 Newton St. WC2. Tel: 01-405-7931

Please send ☐ 36A Spacesaver Drawer Unit
☐ 12A Popular Drawer Unit
Tick where applicable and send cash with orders under £5

NAME .....
ADDRESS E29

WW—068 FOR FURTHER DETAILS

VITALITY

Miniature and Sub-Miniature Indicator Bulbs in sizes from 4.5mm

Catalogue from
VITALITY BULBS LTD
MINIATURE LAMP SPECIALISTS
BEETON'S WAY, BURY ST. EDMUNDS, SUFFOLK. TEL: 2071 STD 0284/2071

WW—069 FOR FURTHER DETAILS

The safest, quick and handy connector for electrical appliances

MAINS **Keynector**

Only 5 x 3 x 1¾in. the MAINS KEYNECTOR is made of non-combustible urea-formaldehyde. Designed in modern style and attractive two-tone colour. The unit eliminates the need of terminating the mains input lead of any electrical instrument or appliance with a plug. Also enables more than one appliance to be connected in parallel and used simultaneously. *Colours:* Duo-Green, Duo-Grey & Duo-Fawn. *Rating:* 13 amp.

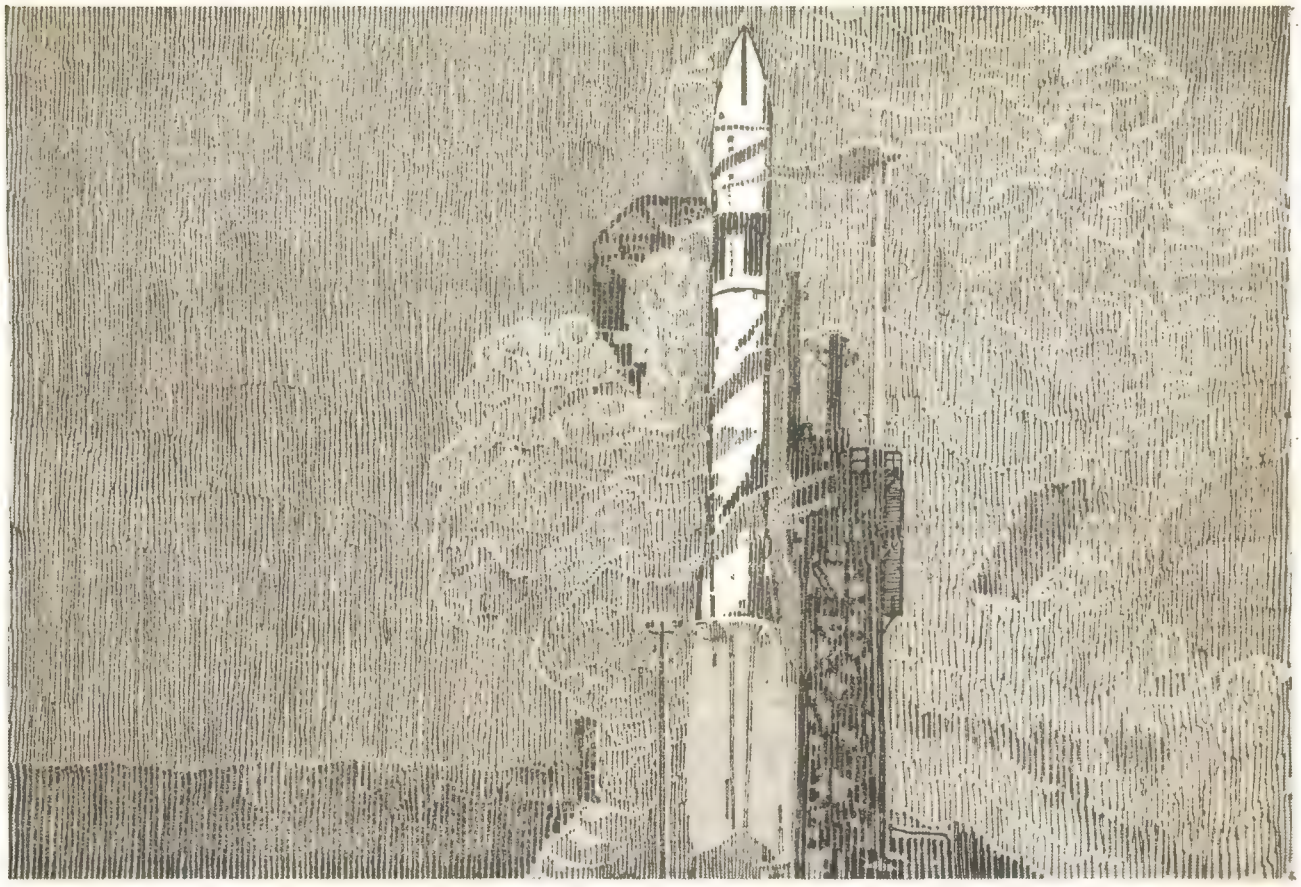
35/- *inc. p. & p.*

British and Foreign Patents applied for

CYBERNAUT CONTROLS LTD. (Ref.W.W.5), 28-30 Rivington St., London, E.C.2.

WW—070 FOR FURTHER DETAILS

Erie take a pride in performance



in aerospace

One of Erie's major contributions to Aerospace programmes comes from their range of subminiature capacitors produced by the exclusive "Monobloc Process". This construction produces Ceramicons, at the heart of which is the Monobloc solid structure of fused ceramic films and stable platinum electrodes, with maximum capacitance-to-volume ratios (up to 380 μF/cu. in.).

The range, made up of a number of styles, provides comprehensive capacitance values, flat temperature characteristics and configurations to suit every application. Although the individual conformal packages within the range vary, each has a common element—the Monobloc dielectric—hermetically sealed and glass encased or precision moulded. These encapsulated units are available with either axial lead or radial lead construction, but there is also a range of unencapsulated Monobloc Chips available for hybrid integrated circuit applications.

Erie have long been pioneers of new processes—now their labours of the past lead them into the future. In the realm of Aerospace systems, as with communications, defence, instrumentation and the whole range of modern electronics . . . Erie take a pride in performance.

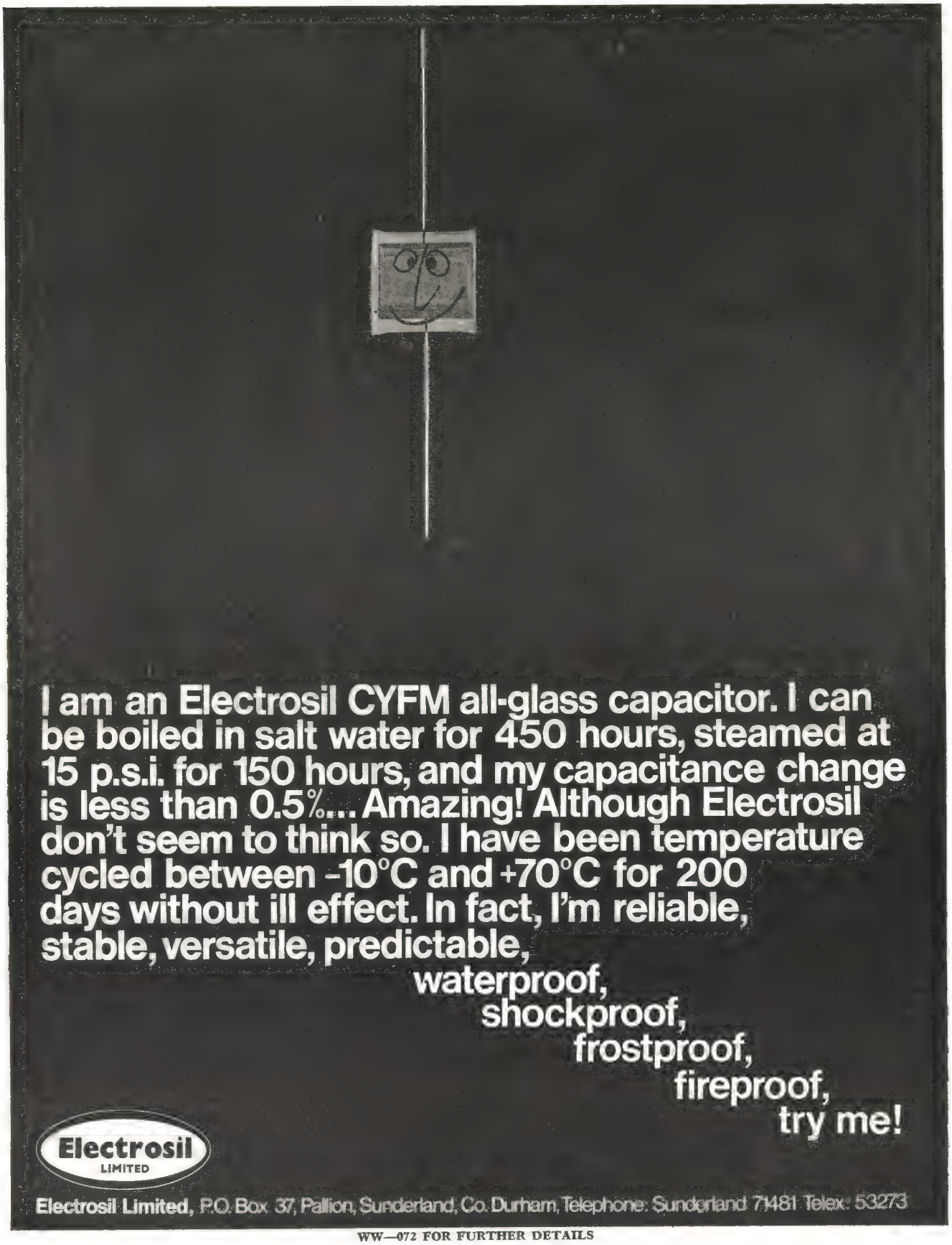
Write for details of Monobloc and Monobloc Chip capacitors to :–

Erie, Monobloc and Ceramicon are registered trade marks of Erie Resistor Limited.

ERIE RESISTOR LIMITED,
Great Yarmouth, Norfolk, England.
Telephone: Great Yarmouth 4911
Cables: Resistor Great Yarmouth
Telex: 97421

ERIE®

WW—071 FOR FURTHER DETAILS


I am an Electrosil CYFM all-glass capacitor. I can be boiled in salt water for 450 hours, steamed at 15 p.s.i. for 150 hours, and my capacitance change is less than 0.5%... Amazing! Although Electrosil don't seem to think so. I have been temperature cycled between -10°C and +70°C for 200 days without ill effect. In fact, I'm reliable, stable, versatile, predictable,
waterproof,
shockproof,
frostproof,
fireproof,
try me!
Electrosil
LIMITED
Electrosil Limited, P.O. Box 37, Pallion, Sunderland, Co. Durham. Telephone: Sunderland 71481 Telex: 53273

WW—072 FOR FURTHER DETAILS

custom-built quality mass produced quantity computer-speed delivery...

Quality, quantity and **speed** . . . they all add up to Harwin precision turned-parts service!

Quality first. Pins, lugs, inserts – in fact any turned part for electronics must be precision-made. Harwin do it to order – any size, any shape.

Now quantity. Thousands? Millions? Harwin can do it at speed . . . with quick delivery and low costs.

It all adds up to Harwin service. Let us have your turned parts problem ....we know three ways we can solve it better!

Harwin do you a good turn! Turned parts – indicator units lugs – stand-offs – brackets – insulators – resistors terminal boards . . . and more.

HARWIN HARWIN ENGINEERS LTD
FITZHERBERT ROAD
FARLINGTON, HANTS.
Tel: Cosham 70451/2/3

WW—073 FOR FURTHER DETAILS

Calling all transmitter designers

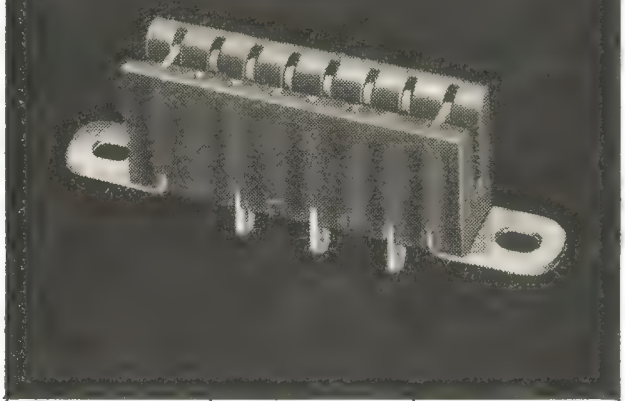
Awaiting your inspection is just about the largest range of **connectors** available anywhere. Made by **Andrew.** To the same high standards as their well-known aerials. They're also experts in the production of **RF switches,** rigid and flexible, **coaxial lines** and **waveguides.** So whatever your design problem . . .

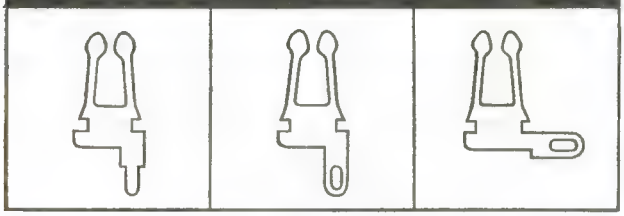
. . . you'll find most of the answers in stock at

Andrew ANTENNA SYSTEMS
LOCHGELLY, FIFE.
Tel: Lochgelly 313. Telex: 72491.

WW—074 FOR FURTHER DETAILS

Permacon edge connectors





35

These inexpensive edge connectors feature polypropylene mouldings and brass or phosphor bronze contacts with a standard tinned finish. Silver plate, gold flash, or gold plate finishes are available to special order. .100" contact pitches provide a maximum of 40 positions whilst the .150" contact pitch range provides for a maximum of 26 positions. Contact tail variations (shown above) include solder slot tails projecting either vertically downwards or at 90° to the moulding, or tails for direct mounting to a "mother" printed circuit board. Mounting brackets provide "closed" or "open-ended" connectors or include contacts for direct earthing from the mating P.C. Board.

Electrical Ratings

Working voltage: 500 Volts D.C. or A.C. Peak (.150" pitch)
350 Volts D.C. or A.C. Peak (.100" pitch)

Current capacity: 5 amps max. per contact

CARR FASTENER CO LTD

the firm with the best connections

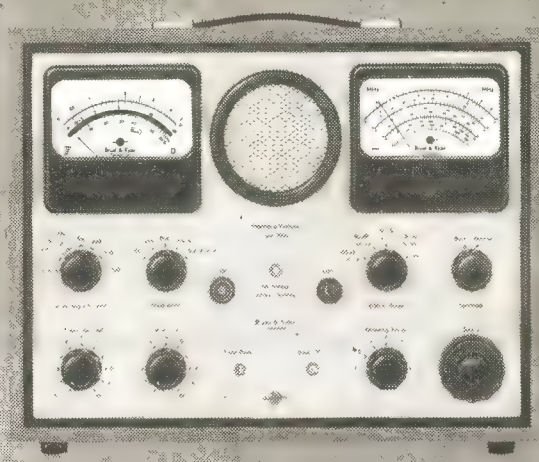
Stapleford, Nottingham
Telephone: Sandiacre 2661
Sales offices: Wembley, Sale

CARR FASTENER
UNITED-CARR GROUP

WW—075 FOR FURTHER DETAILS

BRÜEL & KJÆR

Selective measurements of RF and VHF Voltage, Frequency and Modulation



The Heterodyne Voltmeter Type 2006

By Brüel & Kjær

Specifications

Frequency range: 100 kHz - 230 MHz
Bandwidths: 2.5 kHz and 200 kHz
Sensitivity: 50 μV to 50 V Full scale
Input Impedance: 75Ω unsymmetrical or high impedance probe
Modulation scales: 0-80% AM and 0-80 kHz FM
Power supply: Rechargeable Batteries or Mains

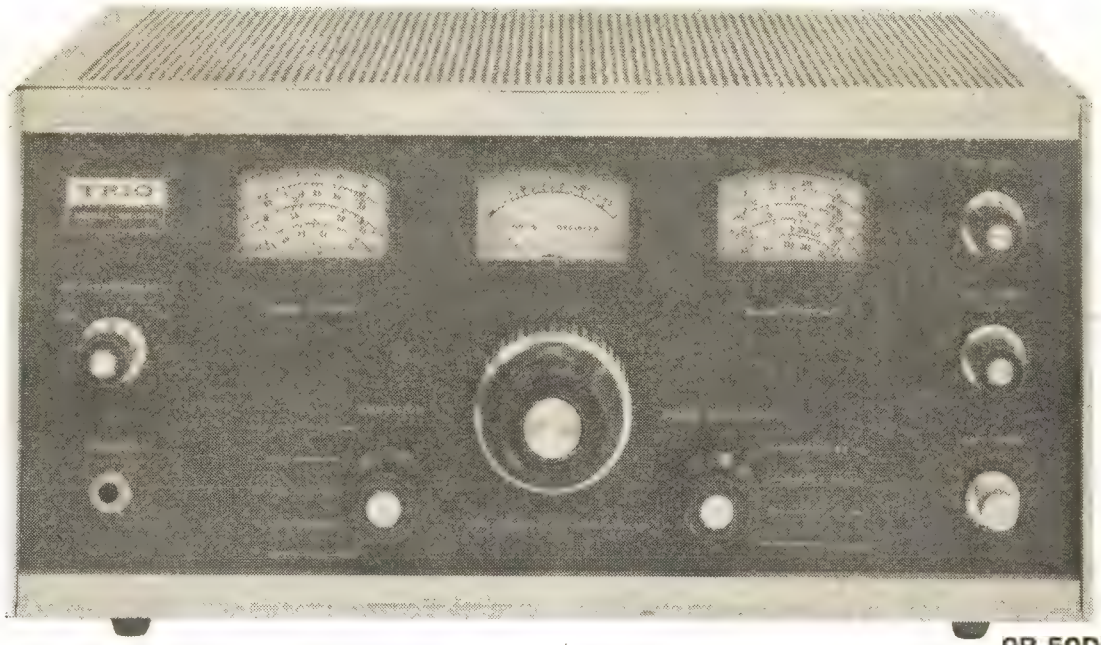
E 67-03

B&K LABORATORIES LTD

4, Tilney Street, Park Lane, London W.1.
Telephone: GROsvenor 4567, Telex 263021 BANKLABS LDN.

WW—076 FOR FURTHER DETAILS

TRIO



9R-59DE

Every Owner Agrees, There's Superb Selectivity and Sensitive Tuning.

Model 9R-59DE

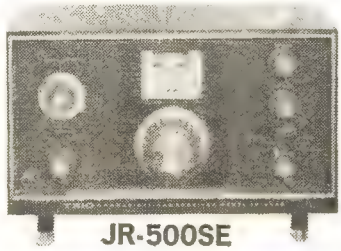
BUILT IN MECHANICAL FILTER 8 TUBES COMMUNICATION RECEIVER

* Illuminated dials permit easy tuning band spread readings.
* Continuous coverage from 550 KHz to 30 MHz and direct reading dial on amateur bands.
* Close callibration accuracy with an excellent anti-backlash mechanism.
* A mechanical filter enabling superb selectivity with ordinary IF transformers.
* One RF and two audio stages of amplification, insuring high sensitivity and selectivity.
* A Product Detector making possible clear SSB reception.
* Frequency Range: 550 KHz to 30 MHz (4 Bands)
* Sensitivity: 2μV for 10 dB S/N Ratio (at 10 MHz)
* Selectivity: ±5 KHz at −60dB (±1.3 KHz at −6dB) When use the Mechanical Filter
* Power Consumption: 45VA at 117 Volts AC. 50/60 Hz.
* Audio Power Output: 1.5 Watts
* Dimensions: Width 15″, Height 7″, Depth 10″.

Model JR-500SE

CRYSTAL CONTROL TYPE DOUBLE CONVERSION COMMUNICATION RECEIVER

* Superior stability performance is obtained by the use of a crystal controlled first local oscillator and also, a VFO type 2nd oscillator.
* Frequency Range: 3.5 MHz−29.7 MHz (7 Bands)
* Hi-Sensitivity: 1.5μV for 10 dB S/N Ratio (at 14 MHz)
* Hi-Selectivity: ±2 KHz at −6 dB ±6 KHz at −60 dB



JR-500SE

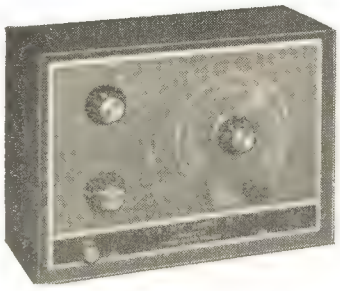
manufactured by TRIO Corporation, Tokyo, Japan.

Sole Agent for the U.K.: B.H. MORRIS & CO., (RADIO) LTD., 84/88, Nelson Street, London E.1, Phone: 01-790 4824

WW—077 FOR FURTHER DETAILS

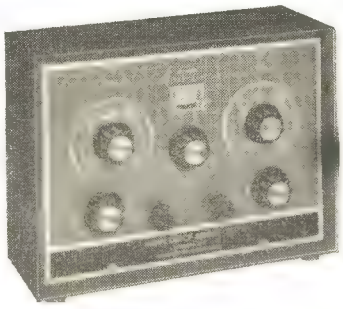
TWO MORE RELEASES BY NOMBREX

IN THE NEW 1967 PRESENTATION



WITH ELEGANT NEW STYLING, IMPROVED PERFORMANCE AND ADDITIONAL FEATURES. SEE AUGUST ADVERTISEMENT FOR BRIEF SPECIFICATIONS OF OTHER NEW 1967 MODELS AT ATTRACTIVE PRICES.

ALL IN FULL PRODUCTION



TRANSISTOR C.R. TEST BRIDGE MODEL 32.

- Wide range measurements
- Improved accuracy 2-4%
- New scale calibrations
- Additional sensitivity control

£10.10.0

Trade and Export Enquiries Invited

6d stamp for full Technical Leaflets

UK Post & Packing 6/6 extra

TRANSISTOR INDUCTANCE BRIDGE MODEL 33.

- 1μH-100H. Q and tan δ
- Direct calibrations
- Meter balance indicator
- Stable and accurate

£20.0.0

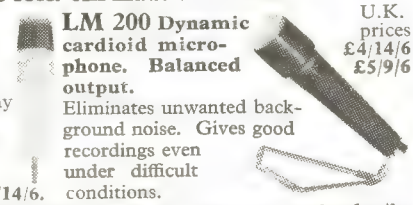
NOMBREX LTD - Exmouth - Devon - England Tel: 3515

WW—078 FOR FURTHER DETAILS

LONDON microphones

Quality sound—at low cost

The London Microphone range offers you quality microphones, good characteristics—and good looks, too, at remarkably little cost. All made in Britain.



LM 100 Dynamic Omni-directional microphone, available in a range of impedances to suit many different input requirements including transistorised tape recorders. U.K. retail price range £2/19/6-£3/14/6.

LM 200 Dynamic cardioid microphone. Balanced output. Eliminates unwanted background noise. Gives good recordings even under difficult conditions.

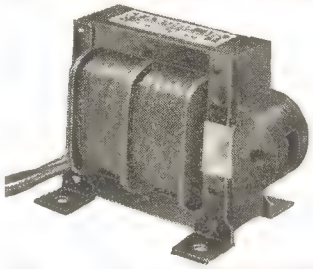
U.K. prices £4/14/6 £5/9/6

Home and overseas trade enquiries welcome. Write or ring for details:

LONDON MICROPHONE CO. LTD
182/4 Campden Hill Road London, W.8. Tel. Park 0711. Telex 23894

WW—079 FOR FURTHER DETAILS

A. C. SOLENOID TYPE SBM

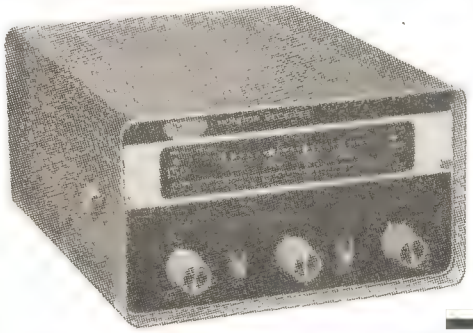


Now fitted with stainless steel guides—six times the life
Continuous 3¾ lb. at 1 in.
Instantaneous to 16 lb.
Larger and smaller sizes available
Also—transformers to 8kVA 3 phase.

R. A. WEBBER LTD.

KNAPPS LANE, CLAY HILL, BRISTOL 5 PHONE 65-7228/9

WW—080 FOR FURTHER DETAILS



SONAR
FR-101 & FR-102:
VHF FM MONITOR RECEIVERS
TUNING 25-50 MHz or 150-175 MHz. Spot cyrstal freq:
12 volts DC & AC Mobile & Fixed Operation.

"SENTRY"
Portable miniature VHF 11ozs receiver. 2 spot crystal channels. 150-175 108-136 MHz. and 25-50 MHz. Also tunes medium waves. VHF transceivers. SSB transceivers

KODEN
Automatic direction finders for marine & land. 150 KHz-30 MHz. Facsimile receivers. Loran 'A' & 'C.'

ASHLEC
Glass fibre aerials MF, HF, & VHF. Special purpose radio equipment.

ASH ELECTRONICS LIMITED *12 Swallow Street, Piccadilly, London. W.1. Tel: REG 7181 Cables ASHLEC*

WW—081 FOR FURTHER DETAILS

WORTH STUDYING FOR

Photo reproduced by kind permission of Women's Journal

A well paid job, security and everything that goes with it can be yours. Look at the situations vacant columns in the newspapers; notice the huge demand for technologists such as electronics, nuclear and computer systems engineers, radio and television engineers, etc. There are many senior positions requiring just the up-to-date, advanced technical education which CREI Home Study Courses can provide.

CREI Programmes are specialised and job-related. Time spent on a CREI Technical Course pays immediate dividends in greater effectiveness and productivity on the job.

Take the first step to a better job now—enrol with CREI, the specialists in Technical Home Study Courses.

POST THIS CARD TODAY

Postage will be paid by Licensee

No Postage Stamp necessary if posted in Great Britain or Northern Ireland

BUSINESS REPLY SERVICE
Licence No. SW 2312

CREI

The highest level of Technical Home Study

C.R.E.I. (London),
Walpole House, 173-176 Sloane Street,
London, S.W.1.

CREI STUDY PROGRAMMES

are related directly to the problems of industry including the latest technological developments and advanced ideas. The new CREI brochure gives details of revised and up-to-date programmes over a wide field of specialisation.

Over 40 years of experience in America is proof enough for 20,000 students currently taking CREI courses throughout the World. Students claim that individual tuition given by the CREI panel of experts in each specialised field is comparable in technological content with that of technical colleges.

WHY A CREI COURSE?

No standard text books are used—these are often 2 years out-of-date when printed. CREI Lesson Material contains information not published elsewhere and is kept up-to-date continuously. (Over £50,000 is spent annually in revising text material.)

Step-by-step progress is assured by the concise, simply written and easily understood lessons.

Each programme of study is based on the practical applications to, and specific needs of, the Electronics Industry.

CREI PROGRAMMES ARE AVAILABLE IN:-

Electronic Engineering Technology - Industrial Electronics for Automation Computer Systems Technology - Nuclear Engineering - Mathematics for Electronics Engineers - Television Engineering - Radar and Servo Engineering City and Guilds of London Institute: Subject No. 49 and Advanced Subject No. 300.

C.R.E.I. (London), Walpole House, 173-176 Sloane Street, London, S.W.1.

Please send me (for my information and entirely without obligation) full details of the Educational Programmes offered by your Institute.

My interest is City and Guilds ☐
General ☐ please tick

NAME **ADDRESS**

EDUCATIONAL BACKGROUND

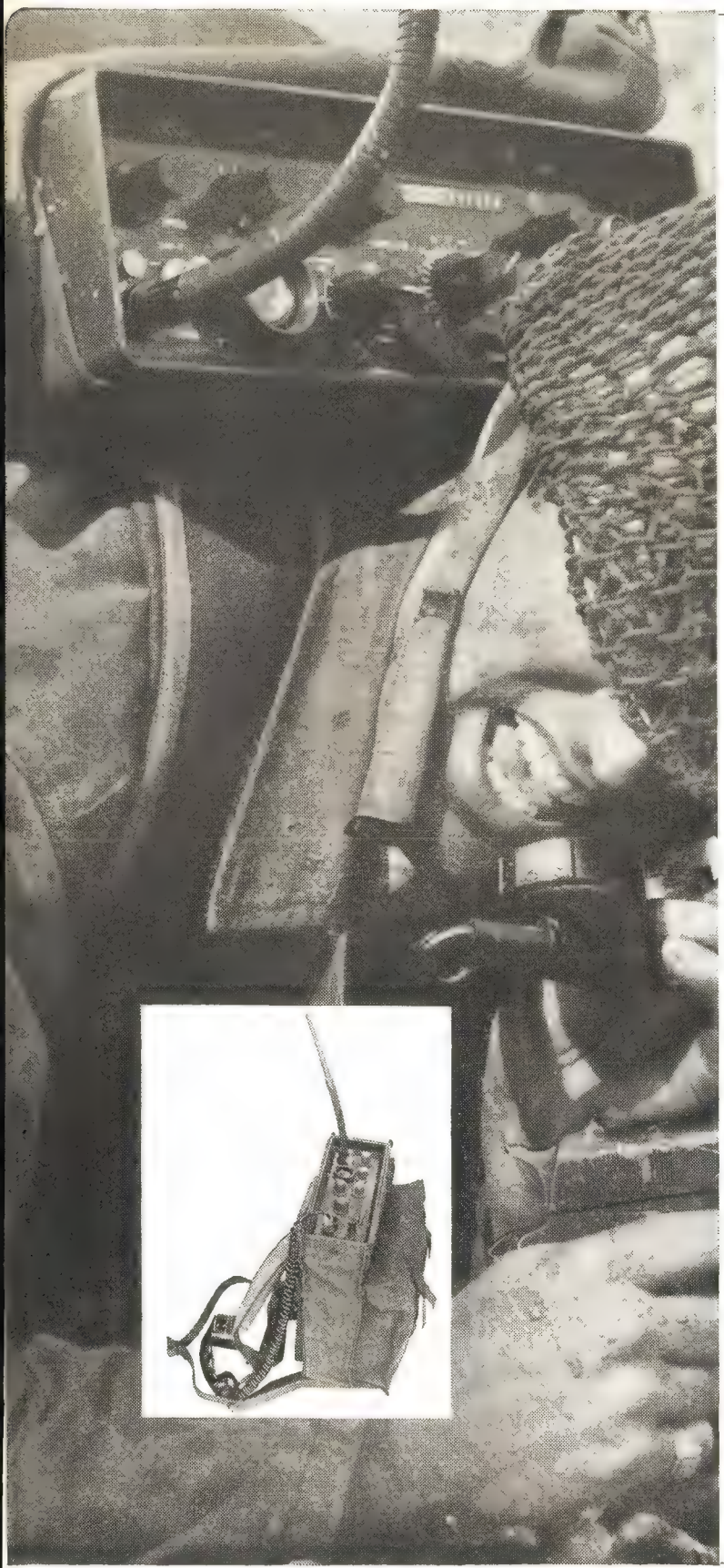
ELECTRONICS EXPERIENCE

**C.R.E.I. (London), Walpole House,
173-176 Sloane Street, London, S.W.1.**

POST THIS CARD TODAY

CREI

The highest level of Technical Home Study



There are times... when he's glad he's got the world's finest packset, like him you can depend on the

RACAL

SQUADCAL

TRA906 PACKSET

Already sold to more than 30 countries, 'Squadcal' proved to be the world's most exciting introduction in HF SSB packsets in 1967. 'Squadcal' is rugged, reliable, lightweight and completely water-proof. Designed specifically for operation by unskilled personnel to meet world-wide military and civil requirements for a low-cost, high efficiency HF SSB packset. Twenty-nine operating channels are available giving SSB voice and telegraphy in addition to compatible AM operation.

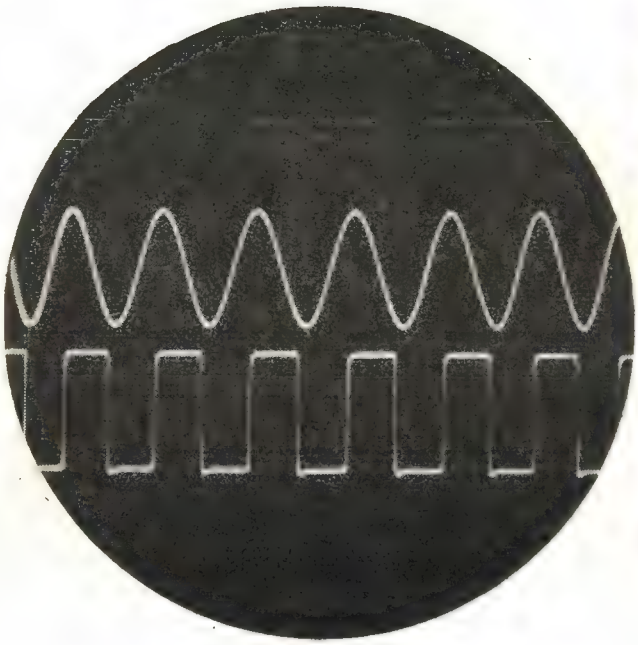
SSB, AM & CW · LIGHTWEIGHT (18 LBS)
LOW COST · FIELD-PROVEN OPERATION:
DESERT–JUNGLE–POLAR · WATERPROOF
29 CHANNELS: 2-7 MHz; 5 WATTS P.E.P./C.W.

RACAL COMMUNICATIONS LTD
WESTERN ROAD · BRACKNELL · BERKS · ENGLAND
TELEPHONE: BRACKNELL 3244 · TELEX: 84166
CABLES: RACAL BRACKNELL

WW—083 FOR FURTHER DETAILS

D

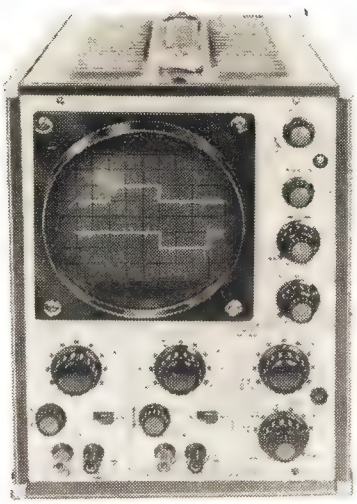
5MHz DUAL TRACE OSCILLOSCOPE



£80

EX WORKS

OS 25



- ✳ DC to 5MHz Bandwidth
- ✳ Dual Trace
- ✳ 100mV/cm Sensitivity on each Channel
- ✳ 1 sec/cm to 0.5µsec Time Base
- ✳ Triggering from either Channel
- ✳ TV Frame Sync.
- ✳ 5" Helical PDA Tube

ADVANCE ELECTRONICS LIMITED

Roebuck Road · Hainault · Ilford · Essex · Telephone 01-500 1000
Telex 263785

WW—084 FOR FURTHER DETAILS

RE-CREATES THE FINER SHADES OF ORIGINAL SOUND

To re-create faithfully the finer shades of original sound, stored as complex mechanical patterns in the micro-grooves of modern records, calls for a cartridge in the precision instrument class. Goldring engineers have spent two years developing such a cartridge . . . the Goldring "800" Free Field Cartridge. At a comparatively modest cost this cartridge rivals the finest in the world, whilst at the same time guaranteeing the complete reliability for which the name "Goldring" has stood for sixty years in record reproduction.

GOLDRING "800" FREE FIELD STEREO CARTRIDGE £12.7.6 tax paid

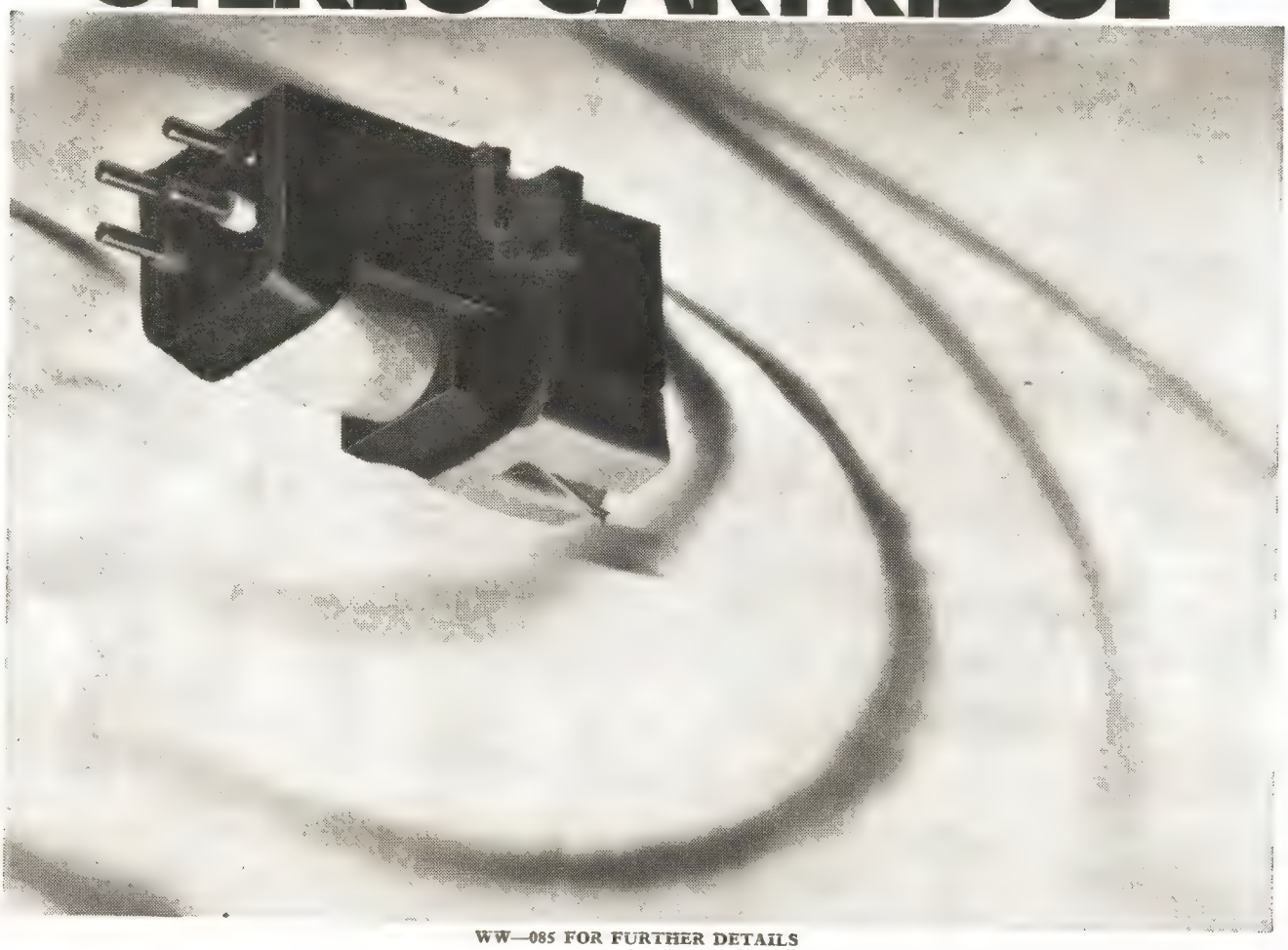
SPECIFICATION

Type	Magnetic—(Free Field)
Frequency Response	20 Hz—20 kHz
Sensitivity	1 mv. per cm/sec.
Separation	25dB at 1kHz and nowhere less than 15dB
Load	100k—47k/ohms
Compliance	20 x 10^{-6} cm/dyne
Stylus	0.0005" diamond replaceable
Effective Tip Mass	1 mg.
Tracking Weight	1—3 grms.
Head Weight	8 grms.
Vertical Tracking Angle	15°

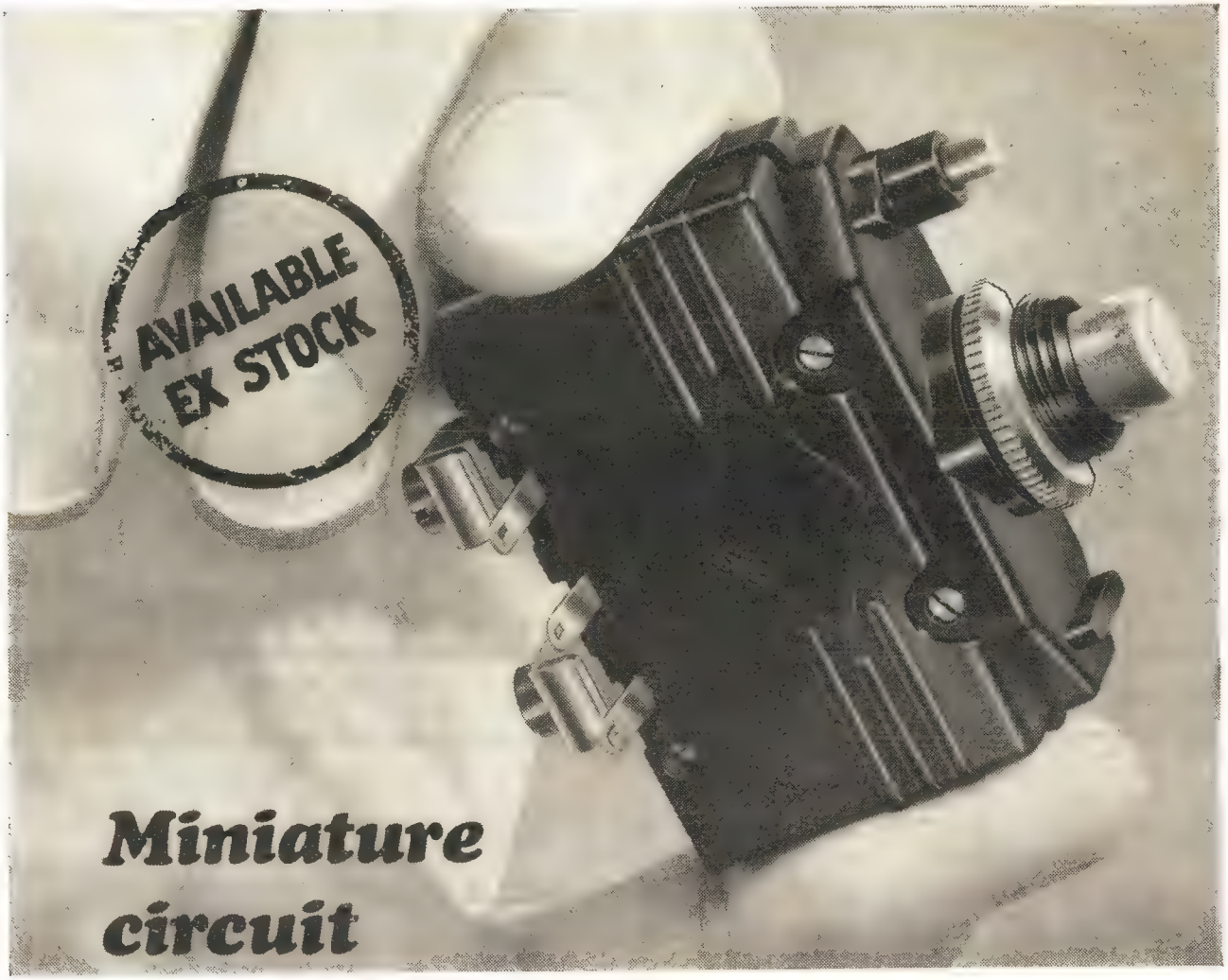
Mu Metal Shield for hum protection.

GOLDRING MANUFACTURING CO. (GREAT BRITAIN) LIMITED
486-488 High Road, Leytonstone, London, E.11

GOLDRING '800' FREE FIELD STEREO CARTRIDGE



WW—085 FOR FURTHER DETAILS



Miniature circuit breakers with BIG Advantages

The Belling-Lee "Securex" Miniature Circuit Breaker is a precision unit which provides protection, switching plus a clear indication of the circuit condition. Two basic types are available, thermal or thermal-magnetic. Available in many ratings from 300 mA to 15 A.

FOR FULL SPECIFICATIONS RING ENF 5393
OR WRITE FOR DATA SHEETS E17-E20

BELLING-LEE COMPONENTS

connecting research to industry

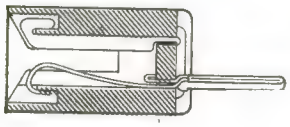
BELLING & LEE LIMITED, GREAT CAMBRIDGE ROAD, ENFIELD, MIDDLESEX

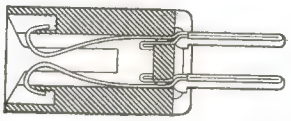
Telephone: 01-363 5393 Telex: 263265

WW—086 FOR FURTHER DETAILS

THIS IS WHERE THE ACTION IS!

THE UNIQUE 'ROLLING LEAF' ACTION OF FERRANTI EWD EDGE CONNECTORS





8 16 24 32 40 POLES

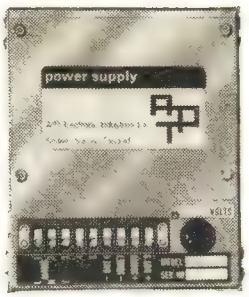
FERRANTI

First into the Future

FERRANTI LTD., KINGS CROSS ROAD, DUNDEE. TEL: (ODU2) DUNDEE 89311

WW—087 FOR FURTHER DETAILS DS/T159

This is an illustration of sixty-two different power units



Concealed behind this 4⅜" x 5⅛" front panel is a standard range of parts manufactured in large quantities, resulting in low production costs. The saving is passed on to you without affecting the superior performance and high reliability. For example, you can have a pre-set unit in the range 11 to 28 volts at 4 amps for as little as £34.

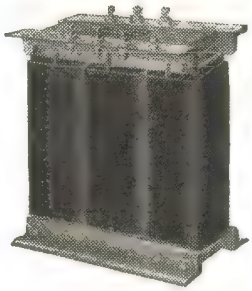
The 62 units in the new Series 30 range cover voltages from 0 to 500 with output currents up to 10 amps, depending on the voltage. A choice of protection circuits is available including 'crowbar' for your integrated circuits.

For complete details of this new approach to power supply design send for Series 30 full-colour folder and price list.

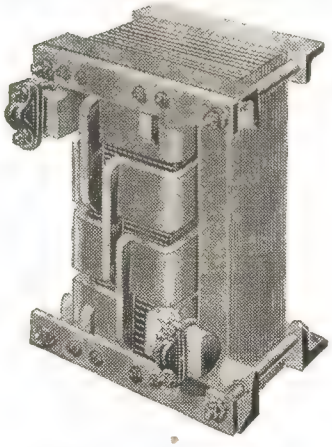
A.P.T Electronic Industries Ltd. Chertsey Rd., Byfleet, Surrey. Tel: Byfleet 41131.

WW—088 FOR FURTHER DETAILS

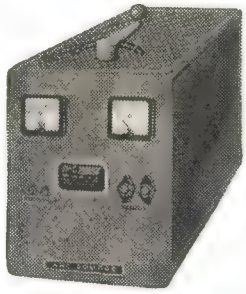
Transformers



Low Voltage High Current Transformers



DC Power Supplies



Voltmobiles

Ask For **Extension 3**

When you phone **Todmorden 2601**

For prompt **information quotations**

And Fast **deliveries**

Transformers

0.25 KVA to 300 KVA
1 phase and 3 phase.

Low Voltage High Current Transformers

with output currents of hundreds, thousands and tens of thousands of Amps.

DC Power Supplies

For Magnets, Accelerators, Plating, Anodising, Spectroscopy, Plasma Arcs, Toronto Arcs, Electron Beams, Electrolysis Welding, Quartz Lamps, Mercury Vapour Lamps.

Voltmobiles

64 step on load switching Auto-Transformers, 1 phase and 3 phase models with output currents from 20 Amps to 400 Amps. Output Volts from zero to 100% or 125% of Input Volts.

VOLTMOBILES are low-cost controllers for furnaces, rectifier sets and other loads.

Harmsworth, Townley & Co.

2, Harehill, TODMORDEN, Lancs.

Phone: Todmorden 2601. Technical enquiries & Sales: Ext. 3.

Progress & Despatch: Ext. 7.

ADCOLA PRODUCTS LIMITED (Regd Trade Mark)

SOLDERING EQUIPMENT

FOR FULL INFORMATION
Apply Direct to:

ADCOLA PRODUCTS LTD.
ADCOLA HOUSE
GAUDEN ROAD
LONDON, S.W.4

Telephone:
MACaulay 0291/3

Telegrams:
SOLJOINT LONDON S.W.4

WW—089 FOR FURTHER DETAILS

ECHO SOUNDER SIGNAL GENERATOR

Frequency Range: 7-60 Kc/s.
Output: 1 Volt—1 Microvolt.

Send for further details of this instrument, and also the

ELLIOTT WIRE RACK &

DIGITAL RESISTANCE-CAPACITANCE BOXES to . . .

The instrument is specially designed for the service engineer, and is suitable for all types of ultrasonic equipment. It has an output meter which can also be used for measuring amplifier gain. The signal generator is also suitable for laboratory use. It can slip into a brief case, or into the leather case available as an optional extra.

ELLIOTT INSTRUMENTS CO LTD
BIGODS HALL, DUNMOW, ESSEX
Telephone: Gt. Dunmow 2422 (0371-2422)

WW—090 FOR FURTHER DETAILS

FAULT LOCATION

KONTAKT "Cold Spray 75"

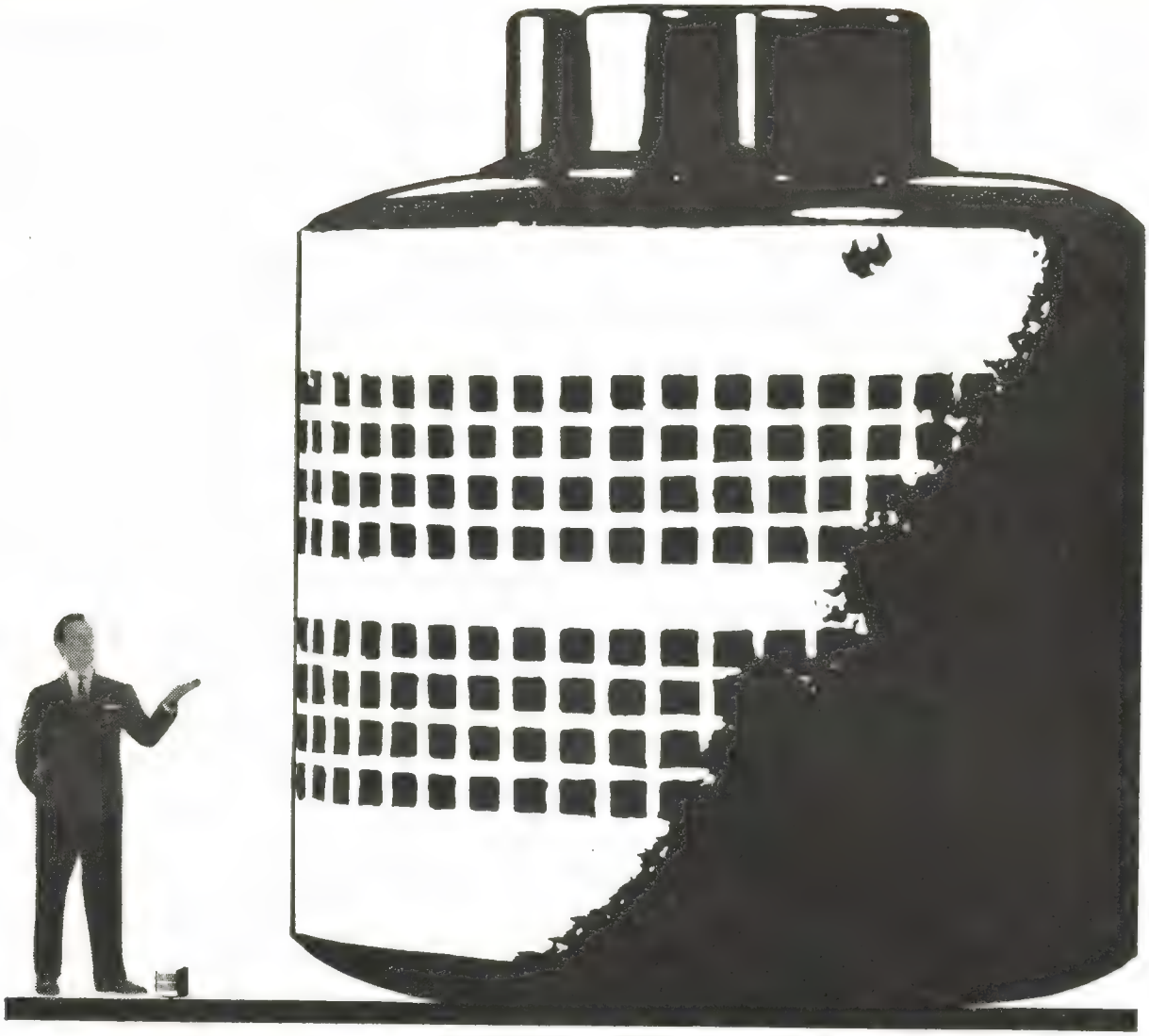
For rapid and effective fault location
Non-toxic, non-inflammable, Cold Spray 75 is a chemically inert coolant capable of producing temperatures of down to —42 centigrade. It can also be used to prevent heat damage during soldering processes, for the rapid freezing of small articles for biological and technical purposes and the prompt location of hairline cracks and other faults in temperature dependent components.

Other Kontakt products:—
Kontakt 60 and Kontakt 61 for relay contact cleaning.
Plastic Spray 70, transparent protective lacquer.
Insulating Spray 72.
Kontakt WL. Spray Wash.
Antistatic Spray 100. Antistatic agent for plastics.
Politur 80. Polish and cleaner.
Fluid 101. Dehydrating Fluid.

Details from UK distributors.

SPECIAL PRODUCTS DISTRIBUTORS LTD.,
81 Piccadilly, London, W.1. Tel: 01-629 9556

WW—091 FOR FURTHER DETAILS



THE VARIAC* variable transformer is the most useful and versatile device ever developed for the control of a.c. voltage, or of current, power, heat, light, speed. It provides smooth continuous adjustment of output voltage from zero to line voltage and above, either hand-operated or motor-driven.

Only Variac has Duratrak* – a patented track surface giving longer life, increased overload and surge capacity and maximum economy in maintenance.

There are over 600 Variac models and assemblies to suit virtually every possible requirement, ranging from small units for laboratory or instrument use to large ganged assemblies for high power 3-phase operation. The range includes low-voltage, high-frequency, dual-output and narrow-range types, open, covered, portable, metalclad and oil-immersed constructions, plus many special models. This is the largest range of variable transformers available today.

The technical superiority and dependability of Variac are the result of over 30 years of development and refinement since the introduction of the first Variac models – the *original* variable transformers.

**'Variac' and 'Duratrak' are registered trade marks*

Variac

REGD

the original and best variable transformers

Variacs are made in England by The Zenith Electric Co. Ltd. London, and exclusively distributed in the U.K. Eire and British Colonies by Claude Lyons Ltd.

Write for comprehensive catalogue to Publicity Department, Hoddesdon

CLAUDE LYONS LTD

Valley Works, Hoddesdon, Herts *Hoddesdon 67161 Telex 22724*
76 Old Hall Street, Liverpool 3 *MARitime 1761 Telex 62181*

WW—092 FOR FURTHER DETAILS

IF THIS IS NOT THE ONE YOU WANT WE STILL HAVE A FEW MILLION OTHERS

FOR EXPORT

VALVES FOR:

Radio and Television Manufacturers.
Radio and Television Service Departments.
Radio Relay Companies
Audio Equipment.
Electronic Equipment.
Instrumentation.
Computers.
Marine Radar.
Communication Equipment.
Research and Development.
Government Department.
Aircraft Military and Civil.

Ministry of Aviation Approved Inspection. Air Registration Board Approved Inspection.

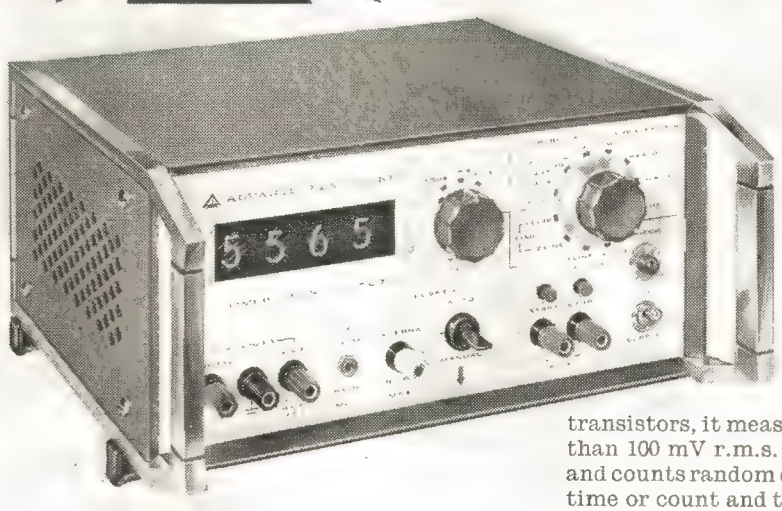
For quality, reliability and world-wide availability, rely on Hall Electric's speed, intelligence and reputation.

HALTRON
RADIO VALVES & TUBES

Hall Electric Ltd., Haltron House, Anglers Lane, London, N.W.5.
Telephone: 01-485 8531 (10 lines). Telex: 2-2573. Cables: Hallectric, London, N.W.5.

WW—093 FOR FURTHER DETAILS

5MHz TIMER COUNTER £130



The Advance TC7 is an entirely new 4-digit timer counter. Using all silicon transistors, it measures frequencies up to 5MHz at less than 100 mV r.m.s. It also measures period and time, and counts random or regular pulses. Single or two-line time or count and three clock units – 10μS, 1mS and 0.1 sec. – can be selected by front panel switch.

4 in-line digits: unique 'dynamic' read-out system: Costs have been saved by the use of a new strobing technique. By cycling the counting stages the need for separate decoding matrices has been eliminated.

At £130, the Advance TC7 is the lowest priced 5MHz timer counter on the market today. Have a look at it! Ask us for a demonstration.

It opens like a book for accessibility. Components are mounted on three hinged printed circuit boards of extremely high quality epoxy resin.

ADVANCE ELECTRONICS LIMITED

Instrument Division · Roebuck Road · Hainault · Ilford
Essex · Telephone: 01-500 1000

WW—094 FOR FURTHER DETAILS

The new improved S51B oscilloscope is backed by the proved performance of well over 15,000 S51A's in use throughout the world.

■ More scope—D.C. X-Amplifier standard ■ Only £55 in the U.K. ■ Large 5″ screen—Bright trace ■ Small size—low weight ■ DC-3Mc/s—100mV cm sensitivity ■ Auto sync and trigger level control ■ Easy to use oscilloscope ■ Ideal for inspection, production control, transistor testing, training, monitoring etc. ■ Specification leaflet ready for you RIGHT NOW! **Serviscope is a registered trade mark of*

TELEQUIPMENT

TELEQUIPMENT LIMITED · 313 CHASE ROAD · SOUTHGATE · LONDON N.14 · TELEPHONE: 01-882 1166
WW—095 FOR FURTHER DETAILS

Wireless World

ELECTRONICS, TELEVISION, RADIO, AUDIO

Editor-in-chief:
W. T. COCKING, F.I.E.E.

Editor:
H. W. BARNARD

Technical Editor:
T. E. IVALL

Editorial:
B. S. CRANK
F. MILLS
G. B. SHORTER, B.Sc.

Drawing Office:
H. J. COOKE

Production:
D. R. BRAY

Advertisements:
G. BENTON ROWELL
(*Manager*)
J. R. EYTON-JONES

Iliffe Technical Publications Ltd., Managing Director: Kenneth Tett Dorset House, Stamford Street, London, S.E.1

Subscribers are requested to notify a change of address four weeks in advance and to return wrapper bearing previous address

© **Iliffe Technical Publications Ltd., 1967.** Permission in writing from the Editor must first be obtained before letterpress or illustrations are reproduced from this journal. Brief extracts or comments are allowed provided acknowledgement to the journal is given.

VOLUME 73 No. 9
PRICE: 3s.

FIFTY-SEVENTH YEAR OF PUBLICATION

SEPTEMBER 1967

415 Is Measurement a Science?

416 *Wireless World* Digital Computer—2

424 Colour Tube Production

433 Tape Pre-amplifier using F.E.T. *by P. F. Ridler*

435 Getting the Best Signals into your Receiver *by T. D. Towers*

440 Speed Control for D.C. Model Motors *by H. M. Butterworth*

443 Standard Frequency Transmissions *by J. McA. Steele*

SHORT ITEMS

423 Marconi Airborne Computer

428 New Receiving Licences and Penalties

432 New Approach to Thin-film Circuits

432 Electrochemical A.C. Time Switch

432 Germanium for I.Cs

REGULAR FEATURES

415 Editorial Comment

428 World of Wireless

430 Personalities

432 Technical Notebook

434 Books Received

449 News from Industry

450 Conferences and Exhibitions

451 Letters to the Editor

454 Literature Received

454 H.F. Predictions

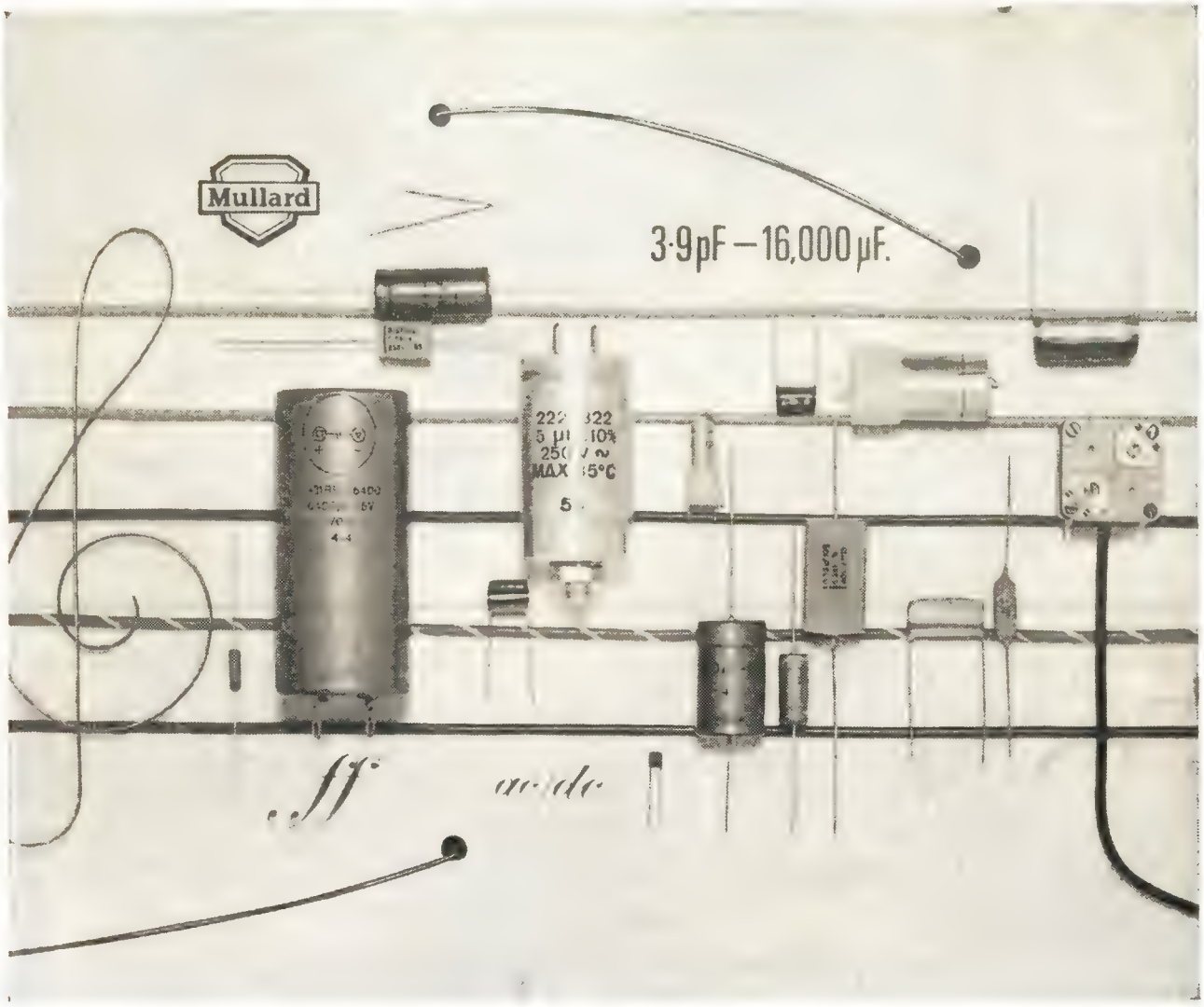
455 World of Amateur Radio

456 New Products

462 Real and Imaginary *by "Vector"*

PUBLISHED MONTHLY (3rd Monday of preceding month). *Telephone:* 01-928 3333 (70 lines). *Telegrams/Telex:* Wiworld Iliffepres 25137 London. *Cables:* "Ethaworld, London, S.E.1." *Annual Subscriptions: Home;* £2 6s 0d. *Overseas;* £2 15s 0d. *Canada and U.S.A.;* $8.00. Second-Class mail privileges authorised at New York N.Y. BRANCH OFFICES: *BIRMINGHAM:* 401, Lynton House, Walsall Road, 22b. *Telephone:* Birchfields 4838. *BRISTOL:* 11 Marsh Street, 1. *Telephone:* Bristol 21491/2. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 123, Hope Street, C.2. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE U.S.A.: 300 East 42nd Street, New York 10017. *Telephone:* 867-3900

The Capacitor Crescendo by Mullard



Ex-stock delivery, competitive prices—music to any radio and TV setmaker's ears. But when you add Mullard quality and Mullard reliability you can see we're adding up to something big.

It's the old problem. How do you keep a competitive edge on your products without the price creeping up? Improve quality and reliability without cutting the profits?

You choose from the eleven Mullard ranges which cover 3·9pF to 16,000µF. Or tell us your requirements. You buy in bulk—just name the quantities. And you get them ex-stock.

The usual ranges are available in :—
Foil/Film; Metallised Polyester Foil; Metallised Polycarbonate Foil; Aluminium Electrolytic; Tantalum Electrolytic; Plate Ceramic and Solid Dielectric Tuning for AM or AM/FM.

Send for information to Mullard Limited, Consumer Electronics Division, Mullard House, Torrington Place, London WC1. Or Telephone 01-580 6633.

Mullard

EMD 198

NT1038

WW—096 FOR FURTHER DETAILS

Wireless World

ELECTRONICS, TELEVISION, RADIO, AUDIO

Is Measurement a Science?

SOME unexpectedly heated discussions at the recent Fourth International Measurement Congress in Warsaw raised the question of whether the process of measurement has in it something unique and intrinsic which entitles it to be considered as a science in its own right. In short, can measurement be isolated from what is measured?

Electronics engineers, although constantly engaged in making measurements, probably never bother to think about it because their interests are centred in a specialized field—the measurement of electrical variables. But when electronic instruments are used to measure other physical variables, such as pressure or temperature, the question does become relevant to our sphere of engineering.

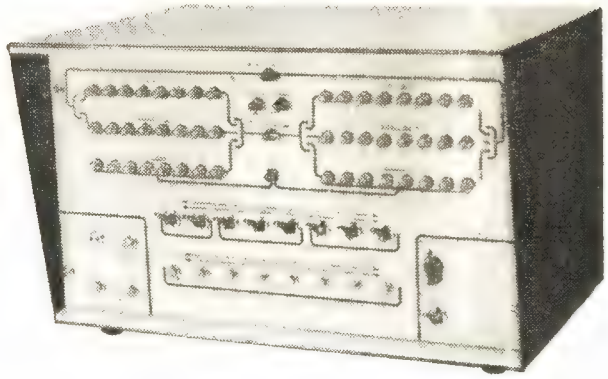
According to Professor P. K. Stein (U.S.A.), who outlined at Warsaw a unified approach to measurement engineering forming the basis of a course at Arizona State University, "measurement is a respectable science in its own right" and provides a unified body of knowledge which can be exploited for engineering purposes. To judge from his lecture, and a paper he distributed at the Congress, the unified approach is largely a matter of forming generalizations and classifications from existing techniques in specialized fields and applying to them new general-purpose names. For example, he speaks of "primary quantities" (those which carry desired information) and "secondary quantities" (the necessarily co-existing physical quantities). Transducers are divided into "self-generating or active" and "non self-generating or passive" types, and in the last-mentioned case there is a "major input" (containing the information to be transmitted) and a "minor input" (providing biasing, a supply, a carrier, etc.). Also, transducers are classified by means of a "transducer space," a three-dimensional diagram. The terms "acceptance ratio," "transfer ratio" and "emission ratio" describe relationships between the primary and secondary quantities. Generalized dicta are of the type: "It is not necessary that the method of carrying the information be the same at the input as at the output of a transducer. Indeed, the function of certain devices is precisely to alter the method of information transfer."

Several of the participants at Warsaw (including ourselves) were very dubious about the value of this approach. It seems to us that in attempting to be truly general, to extract the quintessence of measurement from the dross of what is measured, one is being forced to use terms that are so abstract as to have lost all useful meaning for engineering purposes. The last quotation, for example, may seem highly signficant to somebody who has never met a transducer, but what does it tell him that is really useful? Also, it is very easy to fall into the trap of thinking that by writing down names one is explaining real things. "Measurement," for example, is nothing more than an abstract noun which *can* conjure up a mental concept if one has actually experienced the making of particular measurements. There is no real link between, say, the measurement of strain in human bone and the measurement of voltage ratios in an inductive divider (both of which were the subjects of papers at Warsaw) beyond this purely verbal one.

One of the most sensible remarks made at the Congress was that "the only real way to learn about measurement is to make some measurements." So electronics engineers, in their narrow specialization, need not feel that they are lacking in some greater wisdom which lies beyond their normal horizons.

VOL 73 NO 9
SEPTEMBER
1967

WIRELESS WORLD DIGITAL COMPUTER



2 — System design: the arithmetic unit and store: how information is transferred from one part of the computer to another

THE heart of the "arithmetic unit" shown in our simplified schematic Fig. 1 last month is a unit called the adder/subtracter. The function of the adder/subtracter is to either add or subtract two binary numbers. The digits to be dealt with are fed into the circuit a pair at a time, starting with the 2^0 column, proceeding to the 2^1 column, and so on. At this point we can define six input lines to the adder/subtracter: control signals to tell the unit to add or subtract, and data signals representing the digits to be manipulated, which we shall call A and B that require the four input lines, A, $\bar{A}$, B, $\bar{B}$.

If, as a result of an arithmetic operation, say in the 2^0 column, a "carry" is generated, this carry must be stored until the 2^1 digits appear at the input. Some form of storage is obviously called for, the output of the store being delayed one "digit time" and fed back to the input of the adder/subtracter. This store is called the "carry store" and its outputs are C and $\bar{C}$. The output of the adder/subtracter, the result of the arithmetic operation, will be called the SUM output and this, for reasons to be seen later, will be negated to form, in addition to the SUM output, a NOT sum output ($\overline{\text{SUM}}$).

The carry store is called upon to store only one digit at a time, so this function may be performed by a bistable. As a bistable assumes an indeterminate state at switch-on, a means must be available to reset it; therefore a carry-store reset line is another required input to the adder/subtracter. In the section on binary arithmetic last month it was stated that in order to form the 1s complement of a number it was added to a series of 1s and any carry generated was ignored. This calls for another input, an "inhibit carry" line. Yet another input needed is a "shift pulse", and the reason for this will be explained later. The black box representing the adder/subtracter is shown in Fig. 13.

To add and subtract, the adder/subtracter must produce outputs which obey the rules given in the tables on page 368 last month. First we will consider the addition table, in which the two binary digits to be added are in columns A and B, while column C is the carry from the last operation. Taking the second line down, $1 + 0 + 0 = 1 \rightarrow 0$, this could be rewritten as $A\bar{B}\bar{C}$ = SUM → carry 0, and the line $1 + 1 + 0 = 0 \rightarrow 1$ could be rewritten $AB\bar{C}$ = $\overline{\text{SUM}}$ and set 1 in carry store to be used in next most significant position. All it has been necessary to do is to write A when a 1 appears in column A and to write $\bar{A}$ when an 0 appears in column A.

Using this method and writing the Boolean equation for a sum output we get:

(1) $A\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}\bar{B}C + ABC$ = SUM (remember + means OR) and the equation for a carry to be generated is

(2) $AB\bar{C} + A\bar{B}C + \bar{A}BC + ABC$ = carry.

Referring to the subtraction on p.368 last month the equations are:

(3) $A\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}\bar{B}C$ = ABC + SUM

and

(4) $A\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}BC + ABC$ = CARRY.

Comparing these equations, we find that the equations for a SUM output for adding and subtracting (1) and (3) are identical, and, furthermore, that the carry equations (2) and (4) contain two common terms, $\bar{A}BC$ and ABC. Bearing this in mind, we can rewrite equations (1) to (4) and also take into account our add and subtract control signals:

add $(A\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}\bar{B}C + ABC)$
+ subtract $(A\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}\bar{B}C + ABC)$ = SUM.
add $(AB\bar{C} + A\bar{B}C)$ + subtract $(\bar{A}B\bar{C} + \bar{A}\bar{B}C) + \bar{A}BC$
+ ABC = carry.

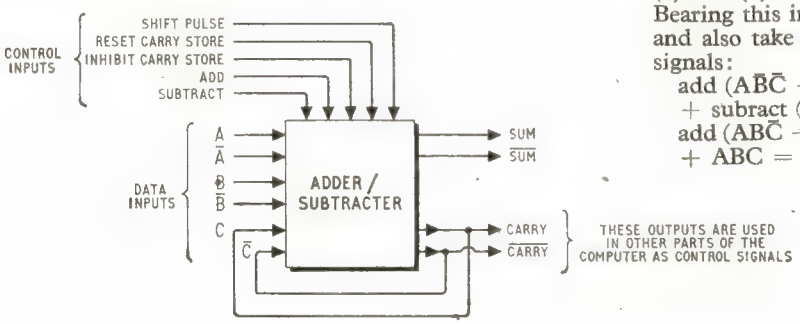


Fig. 13. Black box representation of adder/subtracter, showing inputs and outputs.

The words "add" and "subtract" in these equations are the control signals. It will be noticed that the term ABC is common to both the above equations. From this we can design the adder/subtracter circuit to conform to the equations.

Fig. 14 shows the logical diagram of the adder/subtracter. It can be seen that it is roughly divided into two sections, one for the sum and one for the carry. AND gates 4, 7, 8, 9 provide outputs corresponding to the SUM equation. These are OR gated by OR gate 2 and applied to NOT gate 3. The output of NOT gate 3 is the $\overline{\text{SUM}}$ output. This is applied to NOT 4 to provide the SUM output. When input conditions are such that the SUM and gates 4, 7, 8, 9 outputs are " down," the output of OR 2 can be considered to be an open circuit, the output of NOT 3 will be " up ", providing a $\overline{\text{SUM}}$ output, and the output of NOT 4 will be "down". When the inputs change and a SUM output is required, an AND gate opens and the conditions at the outputs of NOTs 3 and 4 reverse.

Up to bistable 1 the operation of the carry section of the circuit is identical. It will be noticed that AND 4 is common to both the sum and carry circuits (the common term ABC in the sum and carry equations). The terms of the add and subtract equations are AND gated with the " add " and " subtract " control signals. We can now state that each pair of digits (A and B) are presented to the adder/subtracter under the controlling influence of the shift pulse mentioned above. The output of the generator that provides this pulse can normally be considered to be " down ". At a given time the output of this generator goes " up " (negative-going), and stays " up " for the length of the pulse, and then goes " down," forming the trailing edge of the shift pulse (positive-going). On this positive-going trailing edge the next pair of digits appear at the adder/subtracter input and the SUM output of the adder/subtracter is stored.

Bearing this in mind, we will proceed with the description of the carry circuits. We will assume that input conditions are such as to open one of the carry AND gates. The output of NOT 2 will be " up " and NOT 1 " down ". As a result bistable 1 will be set and its output will be " up " (NOT output " down "). Bistable 2 is of the shift-register variety. Reference to Fig. 11 (d) last month will show that the outputs of bistable 1 will provide bias for the input steering diodes D1 and D2. Now the trailing edge of the shift pulse is applied to the S.P. (shift pulse) input of bistable 2. During this trailing edge period three things happen: firstly, this positive change is applied to the switched-on transistor of bistable 2 by the steering diodes to turn it off (setting bistable 2); secondly, a new set of digits appear at the adder/subtracter input; thirdly, the output of the SUM circuit is stored. Bistable 2 (the carry store) is now set so C appears at the adder/subtracter input. If this new set input condition is such as not to require the generation of a carry, all the carry AND gates will be closed, bistable 1 will reset as the output of NOT 1 will be " up ", so on the trailing edge of the next shift pulse bistable 2 will reset, and the CARRY output goes down.

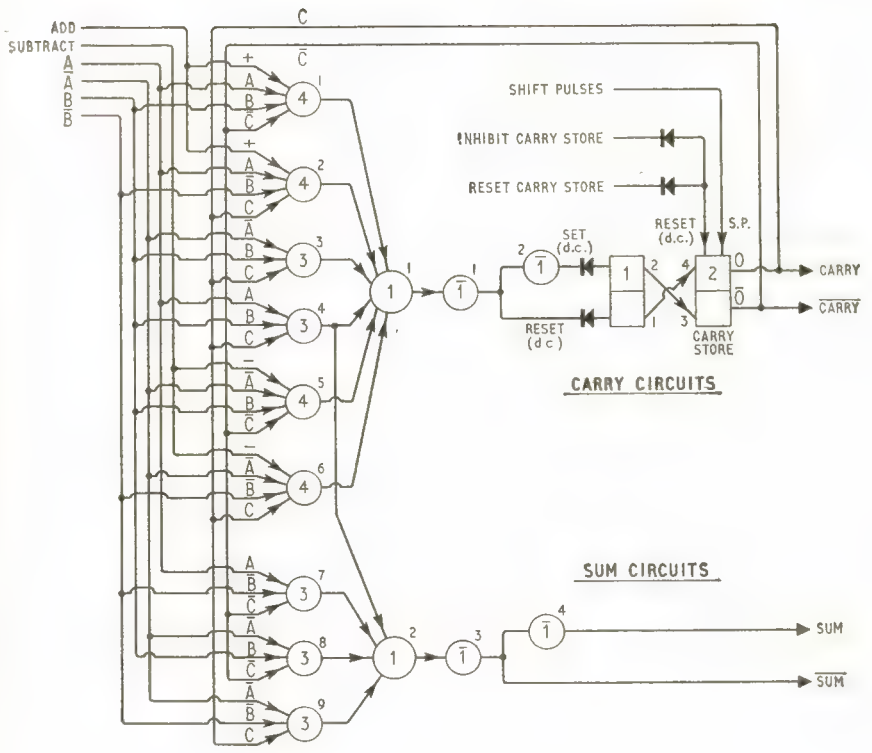


Fig. 14. Logical diagram of adder/subtracter.

This sequence of operations is illustrated in Fig. 15. The reset carry store provides a means of putting the carry store in the reset condition before operations commence. The inhibit carry store input is held up to ensure the carry store can never set during the formation of the 1s complement of a number.

The numbers to be operated on by the adder/subtracter must, as has previously been shown, be applied to the input a pair at a time starting with the least significant position (2^0), and the SUM output must be stored. These functions are carried out by shift registers.

A shift register is capable of storing a binary word, and so the shift registers used in this computer must be capable of holding eight bits. Imagine an oblong block divided into eight separate compartments, each of which will hold one binary digit. This is shown pictorially in Fig. 16. In (a) the shift register compartments all contain 0, and " queued up " at left hand side is a word that is to be placed in the register. The 1 in the 2^0 position of this word is already presented to the input of the register.

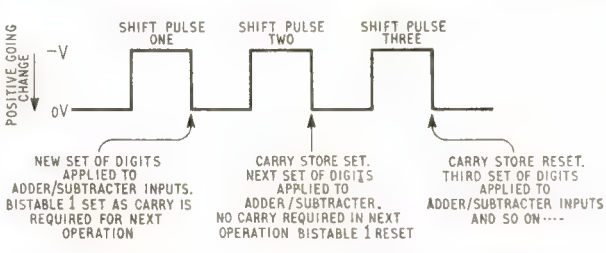

POSITIVE GOING CHANGE
-V
0V
SHIFT PULSE ONE
SHIFT PULSE TWO
SHIFT PULSE THREE
NEW SET OF DIGITS APPLIED TO ADDER/SUBTRACTER INPUTS. BISTABLE 1 SET AS CARRY IS REQUIRED FOR NEXT OPERATION
CARRY STORE SET. NEXT SET OF DIGITS APPLIED TO ADDER/SUBTRACTER. NO CARRY REQUIRED IN NEXT OPERATION BISTABLE 1 RESET
CARRY STORE RESET. THIRD SET OF DIGITS APPLIED TO ADDER/SUBTRACTER INPUTS AND SO ON·····

Fig. 15. Showing how, if a carry is generated, it is delayed by one shift-pulse time.

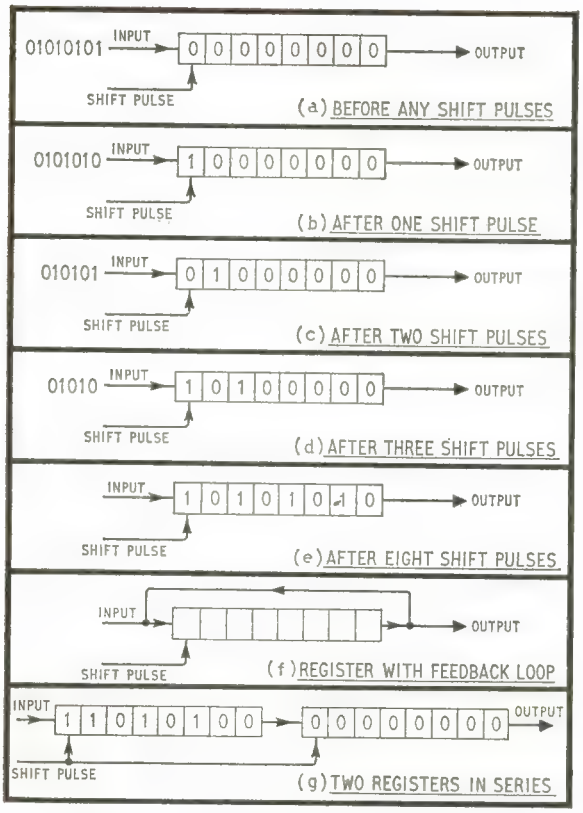

01010101
INPUT
0 0 0 0 0 0 0 0
OUTPUT
SHIFT PULSE
(a) BEFORE ANY SHIFT PULSES
0101010
1 0 0 0 0 0 0 0
(b) AFTER ONE SHIFT PULSE
010101
0 1 0 0 0 0 0 0
(c) AFTER TWO SHIFT PULSES
01010
1 0 1 0 0 0 0 0
(d) AFTER THREE SHIFT PULSES
1 0 1 0 1 0 1 0
(e) AFTER EIGHT SHIFT PULSES
(f) REGISTER WITH FEEDBACK LOOP
1 1 0 1 0 1 0 0
0 0 0 0 0 0 0 0
(g) TWO REGISTERS IN SERIES

Fig. 16. Principle of shift register operation.

If now a pulse is applied to the S.P. input, the 1 in the 2^0 position will enter the extreme left-hand compartment, as shown in (b). Another shift pulse will move in the word one further position, (c) and so on. After eight pulses have been applied the register holds the complete word, (e).

If further pulses were applied each digit would appear at the output in turn, starting with the 2^0 position. This is precisely what we require to feed the adder/subtracter. After eight pulses the register would be "empty". If a register containing a word is connected as shown in Fig. 16 (f) and eight pulses are applied, each digit appears at the output as before, but now the output is connected back to the input, so the word re-enters the register, returning to its original position. Proceeding further, if two registers were connected as in (g) and eight shift pulses were applied to both registers simultaneously, the word held in the left-hand register would end up in the right-hand register.

Having now dealt with the register as a black box, we can consider the logical diagram of the device, Fig. 17. As can be seen, the shift register consists of eight bistables of the type depicted in Fig. 11 (d) last month, each bistable forming one of the compartments shown in Fig. 16. When a bistable is set, its output is " up " and it can be considered to contain a binary 1. When it is reset, its NOT output is " up ", corresponding to a binary 0 being stored. The state of each bistable determines which of the steering diodes in the bistable next in line is biased on or biased off. In this way shift pulses are steered to the appropriate transistor in each bistable so that on the trailing edge of a shift pulse each bistable will assume the state of the bistable immediately on its left.

Five shift registers are used in the basic computer. Two of these require a common reset line that is d.c. coupled to each bistable (Fig. 11). When this line goes negative the register is " cleared ", that is, all bistables are reset and the register contains eight 0s. A " set d.c." facility has to be provided for each bistable in the other three registers. This allows individual bistables to be set to enter a word into the register in parallel (all digits simultaneously). To avoid confusion all the inputs and outputs that each black box requires will not be shown in future explanatory diagrams—only those relevant to the points under discussion will be shown.

Fig. 18 depicts the adder/subtracter connected to two shift registers. One of these registers has been called the accumulator, because it not only holds the word that will provide the A and $\bar{A}$ inputs to the adder/subtracter but also accumulates the result of each operation performed by the adder/subtracter. The second register is simply called a register. This holds the B and $\bar{B}$ inputs to be fed to the adder/subtracter. It has a regenerative loop, as shown, and this means that each digit the register holds is sequentially fed to the adder/subtracter and is also fed back to the input of the register. Any word held by the register will therefore circulate. The C and $\bar{C}$ inputs to the adder/subtracter are internal to this unit and are provided by the output of the carry store as previously described. Though it is not quite so obvious, the accumulator also has a regenerative loop. This is completed by the connection of the SUM output of the adder/subtracter to the input of the accumulator.

We now have a working unit, and it would be helpful to use this to analyse in detail the addition of two binary words. During this analysis the reader is asked to refer

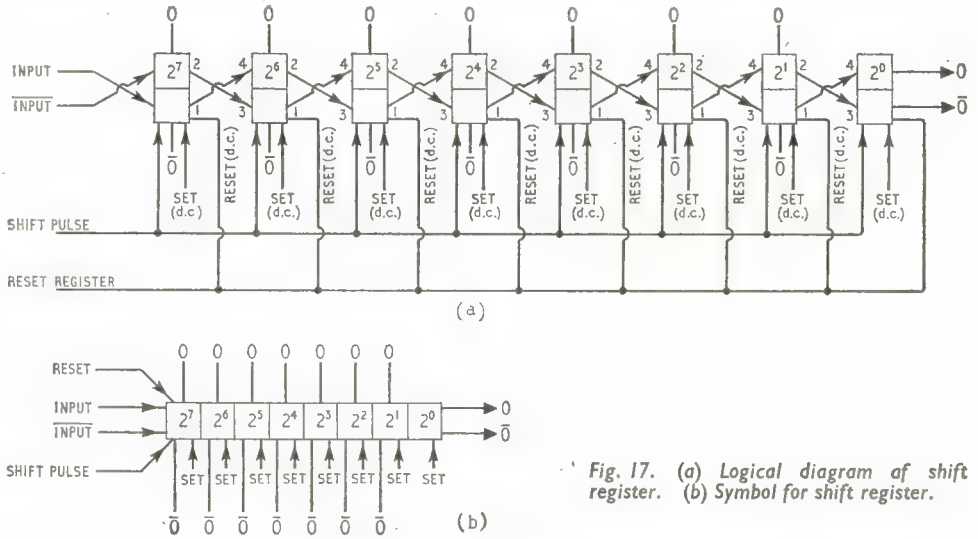


Fig. 17. (a) Logical diagram of shift register. (b) Symbol for shift register.

to Fig. 14 (adder/subtracter logical diagram) and Fig. 18 (part of arithmetic unit). It will also be helpful to consider the addition of the two words used in the binary arithmetic section last month to demonstrate binary addition. These, when extended to eight bits, are:—

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
0	0	0	0	1	1	1	1	A accumulator
+ 0	0	0	0	0	1	1	0	B register

First we will reset all bistables in the unit and then place 0 0 0 0 1 1 1 1 in the accumulator and 0 0 0 0 0 1 1 0 in the register. Assume that the S.P. inputs of the adder/subtracter, accumulator and register are connected together to ensure that all will receive simultaneous shift pulses, and that the "add" input of the adder/subtracter is "up" and the "subtract" input down.

Before first shift pulse 2^0—The inputs of the adder/subtracter are $A\bar{B}\bar{C}$, and gate 7 is open. The SUM output is "up" as is the input to the accumulator.

On trailing edge of first shift pulse—The SUM output sets the 2^7 bistable in the accumulator (which is vacant as the contents of the register and accumulator have simultaneously moved one place to the right). Also by virtue of the register regenerative loop the 0 that was in the 2^0 position of the register is now written in the 2^7 position.

Before second shift pulse 2^1—Inputs to the adder/subtracter are now $AB\bar{C}$. All sum AND gates are closed, so the SUM output is "down." Carry AND gate 1 opens to set bistable 1 (bistable 2 will not set at this stage).

On trailing edge of second shift pulse.—Contents of accumulator and register shift one place to the right. The SUM output of the 2^0 operation moves to the 2^6 position of the accumulator and the $\overline{\text{SUM}}$ output of the 2^1 operation writes an 0 in the 2^7 position. The 1 in the 2^1 position is written in the 2^7 position of the register. Because bistable 1 was set the carry store also sets.

Before third shift pulse 2^2.—Inputs to the adder/subtracter are now ABC (as carry store is now set) AND gate 4 opens, dictating a SUM and carry output. As a result, bistable 1 is held set.

On trailing edge of third shift pulse.—Accumulator and register shift one place to right. SUM output sets 2^7 in accumulator (accumulator contents are now $2^7=1$, $2^6=0$, $2^5=1$). Carry store remains set as bistable 1 was set.

Before fourth shift pulse 2^3.—Inputs to adder/subtracter are now $A\bar{B}C$. SUM output "down," bistable 1 set as AND 2 is open.

On trailing edge of fourth shift pulse.—An $\bar{0}$ is written in 2^7 in the accumulator because of the $\overline{\text{SUM}}$ output. The accumulator now holds ($2^7=0$, $2^6=1$, $2^5=0$, $2^4=1$). Carry store remains set.

Before fifth shift pulse 2^4.—Inputs to adder/subtracter are now $\bar{A}BC$. AND 9 opens, SUM output goes "up." Bistable 1 resets as no carry AND gates are open.

On trailing edge of fifth shift pulse.—SUM output written in the 2^7 position of the accumulator, which now holds ($2^7=1$, $2^6=0$, $2^5=1$, $2^4=0$, $2^3=1$, $2^2=0$, $2^1=0$, $2^0=0$). Because bistable 1 was reset the carry store now also resets.

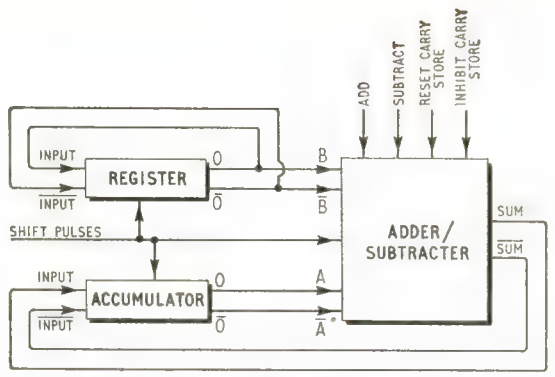


Fig. 18. "Skeleton" of the arithmetic unit.

So far five shift pulses have been applied. Eight shift pulses are required in all to complete the operation. For all the further shift pulses the input to the adder/subtracter will be $\bar{A}\bar{B}\bar{C}$, so all AND gates will be closed and no SUM or carries will be propagated. However, each additional shift pulse will move the contents of the accumulator and register a place to the right, at the end of the operation the accumulator will hold 0 0 0 1 0 1 0 1, which is the result of the addition, and the register, because of the regenerative loop, will hold 0 0 0 0 0 1 1 0.

The reader is now invited to analyse what would happen if the "subtract" input of the adder/subtracter were "up" and the "add" input "down" and eight further shift pulses were applied. This is subtracting the word that we have just added, and therefore the accumulator should contain its original number 0 0 0 0 1 1 1 1 at the end of the operation.

One limitation of the circuit now emerges. It is only possible to subtract the contents of the register from the contents of the accumulator and not vice versa, i.e. A−B only and not B−A.

It will be remembered that the formation of the 1s complement of a number was performed by adding it to a series of 1s and preventing any carries from being generated. The word to be complemented is placed in the accumulator, and adder/subtracter control signals are applied as follows. "Add" is "up," "subtract" is "down," and inhibit carry store is "up" (this means that the carry store cannot set so the C input to the adder/subtracter can never go "up"). To avoid the necessity of setting all the bistables in the register to provide the series of 1s, all that is done is that the "set d.c." input of the 2^0 bistable in the register is made to stay "up" for the complete operation. This means that the 2^0 bistable cannot reset and therefore B is "up" at the input of the adder/subtracter for the entire operation. This has the same effect as setting all the bistables in the register. If under these conditions eight shift pulses are applied, the word in the accumulator will be complemented, as was shown in the binary arithmetic section, i.e. 1+0=1 and 1+1=0 ignore carry.

If we had a button that when pressed provided eight shift pulses to the register, accumulator and adder/subtracter, then, with the circuit of Fig. 18 we could add, subtract and complement with the press of a button. If we put the binary equivalent of decimal 7 in the register, selected "add," and pressed the button four times, the result in the accumulator would be 7+7+7+7

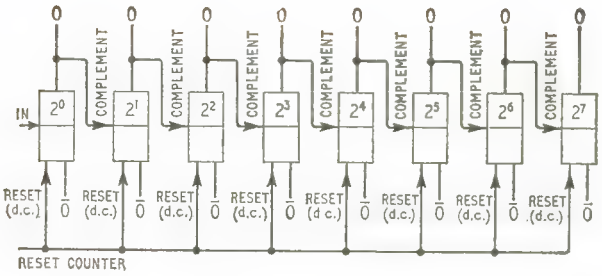


Fig. 19. Counter logical diagram.

$=28$, which is the same as 4×7. In other words we have multiplied 7 by 4. However, this is a rather cumbersome method of multiplying, especially if the multiplier is, say, 50, requiring that the button be pressed 50 times. So, in order to multiply, what is required is some method of performing addition the number of times specified by the multiplier. This is achieved by storing the multiplier in a shift register, which will be called store 1. The multiplicand, which is held in the register, is continuously added to the contents of the accumulator, each addition being counted on a counter. The contents of the counter are continuously compared with the contents of store 1 (the multiplier) and when these two numbers are equal the additions are stopped. The multiplicand will have then been added to the accumulator the number of times specified by the multiplier.

The counter used in this multiplication process consists of a chain of bistables, as shown in Fig. 19, one word-length long. They are of the counter type depicted in Fig. 11(c). The output of each bistable is connected to the " complement " terminal of the next. Each stage will divide by two and the counter will count according to the rules of natural binary as shown on p.367 last month. Bear in mind that each input pulse to this type of bistable will reverse its condition and that this will only happen on a positive-going edge, i.e. the preceding bistable's output going from " up " to " down." It will also be noticed that a common reset line is provided to ensure that the counter starts at 0. It is left as an exercise for the reader to work out the condition of the various bistables in the counter for each successive input pulse. This should conform to the table given last month. As eight places are involved the final count will be $255_{(10)}$ or $11111111_{(2)}$ After this the next pulse will return the counter to all 0s and the counter will start again.

Two other units are necessary for the multiplication process. These are a store (labelled Store 1) and a comparator. Store 1 is a standard shift register; it does not require a common reset line but individual d.c. set inputs have to be provided for each bistable. The comparator must be able to determine when the word held in store 1 is the same as that held in the counter. It has two outputs which are called EQUAL and $\overline{\text{EQUAL}}$. To achieve this it is necessary to compare the output and the NOT output of each bistable in store 1 with the output and the NOT output of the corresponding bistable in the counter. Eight comparator gates (Fig. 9 last month), three AND gates and one NOT gate are required. The logical circuit is shown in Fig. 20. For the EQUAL output to be able to go " up," AND 12 must go " up." For AND 12 to go " up " both AND 10 and AND 11 must be " up." For AND gates 10 and 11 to be " up " all the comparator gates must be " up." Finally, for all the comparator gates to be " up " the bistables in the counter and store 1

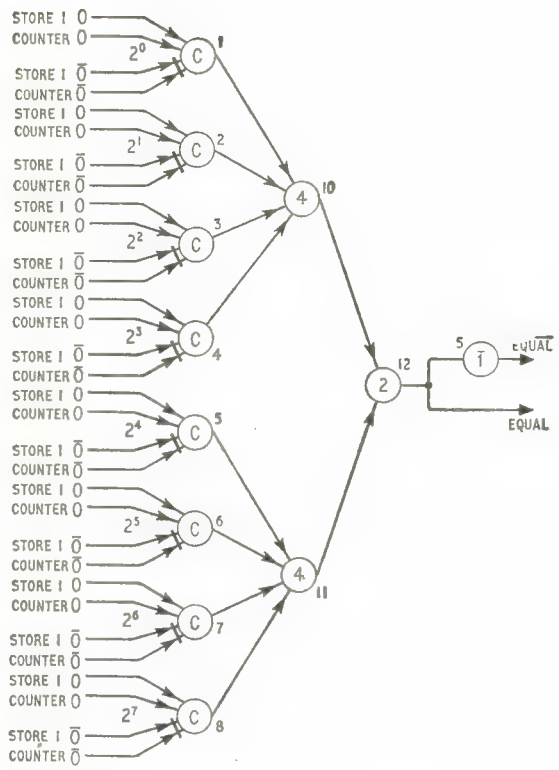


Fig. 20. Comparator logical diagram.

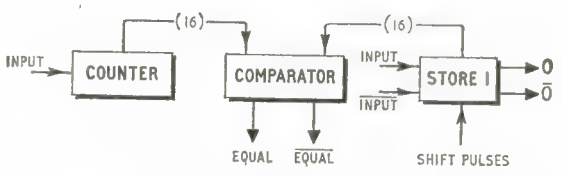


Fig. 21. Showing method of comparing the contents of the counter and the store.

must be in identical conditions. For any other condition the EQUAL output will be " up." Fig. 21 shows how the interconnection of the counter, comparator and store 1 are drawn symbolically, the " 16 " interposed in the single wires to the comparator showing that there are in fact 16 wires.

We have not yet discussed division. Although this does not introduce any real difficulty, the explanation is best left until later on. At present our computer consists of two divorced units with no method of inter-communication. These are the skeleton arithmetic unit shown in Fig. 18 and the counter/comparator/store 1 assembly shown in Fig. 21. It is necessary now to integrate these two units, and to do this some extra gating and a further two storage registers will be introduced. These storage registers are used to hold words for future use by the arithmetic unit of the computer or to store the results of calculations. Fig. 22 shows the new logical diagram of the computer. It is a more complete representation of how the machine is organized, and the reader is advised to become well acquainted with this diagram. A number of the inputs and outputs to various parts of the computer do not appear to be connected to anything at all. All these connections either go to or come from the order decoder

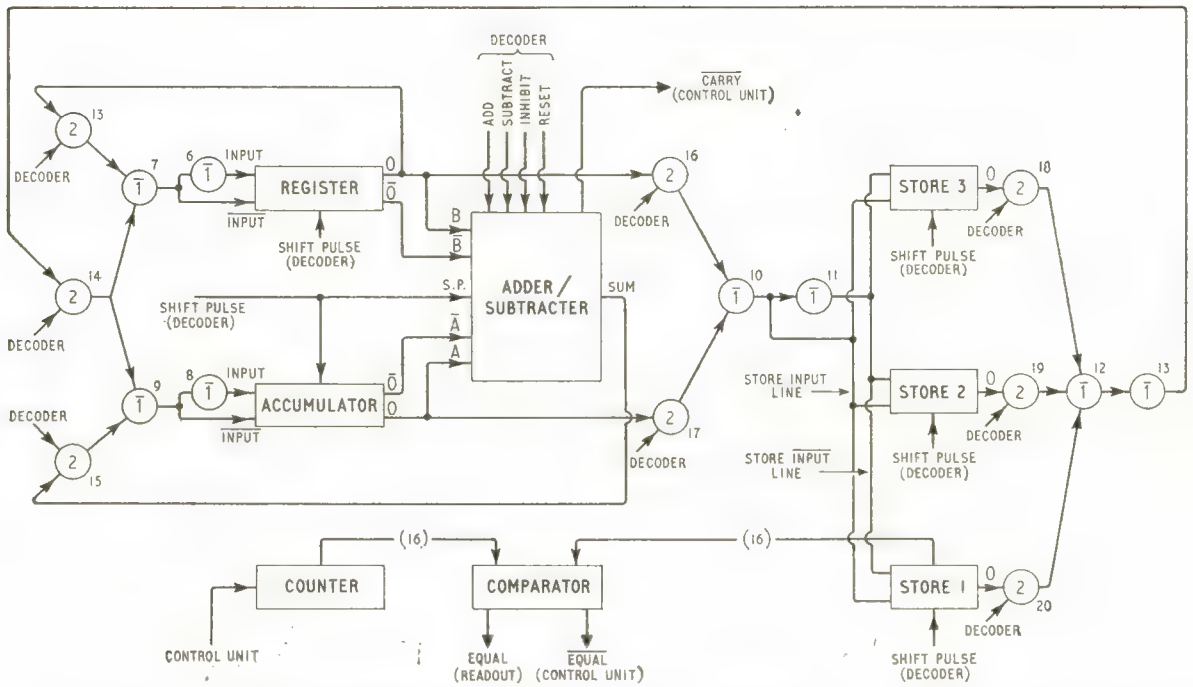


Fig. 22. A more complete logical diagram of the computer showing interconnections of the arithmetic unit and the store.

or the control unit and are marked either DECODER or CONTROL UNIT to indicate this.

It is necessary to be able to move words (data) about the computer from the stores to the register or accumulator and vice versa. Most of the extra gating shown in Fig. 22 is included for this purpose.

When it is desired to perform an arithmetic operation the outputs from the order decoder close all the AND gates of Fig. 22 with the exception of AND 13 and AND 15; these complete the feedback loop of the register and connect the SUM output of the adder/subtracter to the input of the accumulator. This loop is similar to that depicted in Fig. 18 with one important difference; the NOT output of the register and the SUM output of the adder/subtracter are not fed back as was done before. Instead, the NOT outputs are reformed by negating the outputs at the inputs of the register and accumulator by the NOR gates 6 and 7, and 8 and 9, respectively. This results in an economy of components as control gating has only to be applied to the outputs and not to the NOT outputs.

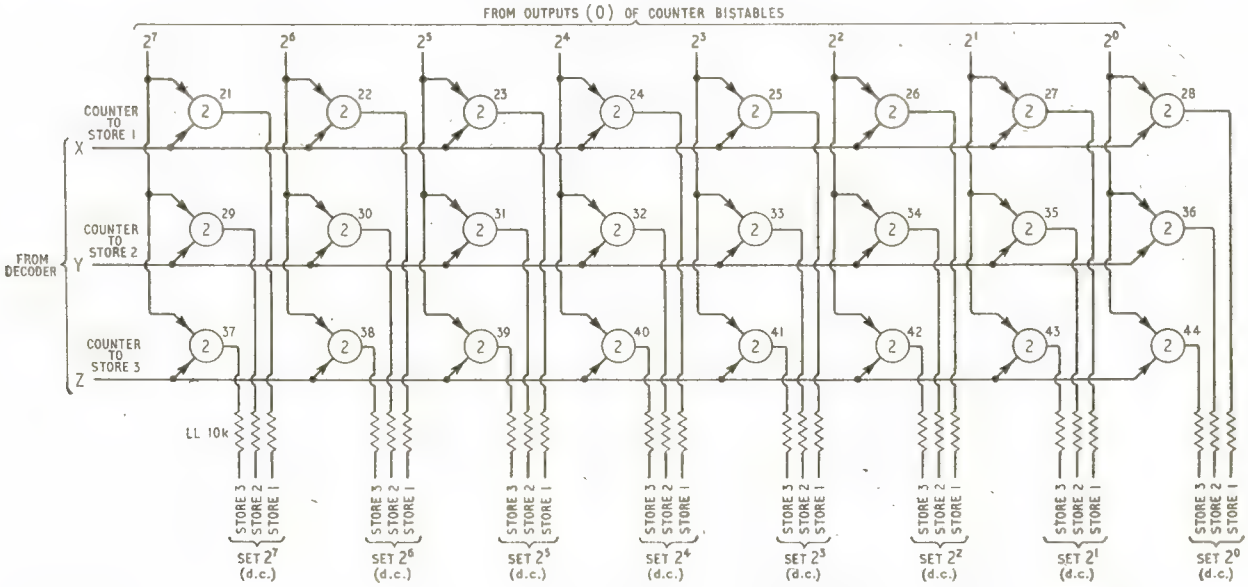


Fig. 23. The counter transfer gating unit logical diagram; note the 10k resistors in series with the outputs.

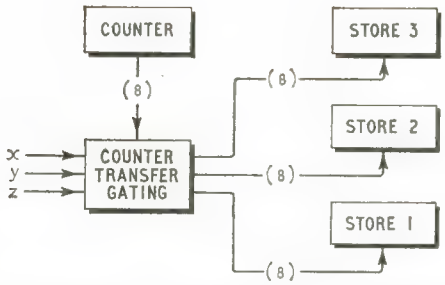


Fig. 24. Showing how data held in the counter is transfered to the store. (The numbers on the interconnections indicate number of wires.)

If it is desired to add or subtract, the appropriate instruction is given to the adder/subtracter by the decoder, which also applies 8 shift pulses to the register and accumulator. When it is wished to multiply, the multiplier is put in store 1, by a method to be described, and the multiplicand is put in the register. The order decoder tells the adder/subtracter to add and tells the control unit that multiplication is to take place. At the start of each addition the control unit provides an input pulse to the counter which advances by 1. At the end of the addition, which has resulted in a pulse to the counter that makes the contents of the counter equal to the contents of store 1, the EQUAL output of the comparator is "down." This informs the control unit that multiplication is complete and no further additions take place.

Division is performed by continuous subtraction, as was shown in the binary arithmetic section. If, for instance we wish to divide 16 by 4, we could subtract 4 four times to get our answer. So 16 could be put in the accumulator and 4 in the register (A−B) and the counter could be fed from the control unit in such a way as to count each subtraction. The control unit could be told to stop the subtractions when the accumulator was reduced to 0. This would work well if the divisor were a factor, as in our example (16÷4). What would happen if the divisor were not a factor, say 17÷4? The contents of the accumulator after each subtraction would be as follows: 17, 13, 9, 5, 1, −3, −7 . . ., etc. In other words, the accumulator contents would not be reduced to zero at the end of a subtraction and the computer would not stop. In view of this the computer is told to subtract until the accumulator contents go negative. This may be conveniently detected by the carry store being set at the end of a subtraction. From our example it can be seen that this occurs when the accumulator holds −3, but to achieve this we have performed five subtractions and the counter will hold five as an answer, which is obviously incorrect. So this procedure is again modified. When the control unit is instructed by the decoder that division is to take place it provides one output pulse to the counter for every subtraction except the last one, so the counter will hold the number of subtractions −1 at the end of the operation. In our example 17÷4, the counter will hold 4, which is correct. The accumulator holds −3 and the register holds the divisor which was 4. If we now add, the accumulator will hold −3+4=1 which is the remainder. After division and the subsequent addition the counter holds the quotient and the accumulator holds the remainder.

Now suppose we want to keep this remainder for a further operation and before we need it we have to perform another arithmetic operation which will require the use of the accumulator. We will therefore have to transfer the 1 in the accumulator to a store, say store 3. So the order decoder will be instructed to transfer the contents of the accumulator to store 3. Gate 15 will close. Closing the accumulator feedback loop, gate 17 will open, providing the accumulator output access to the store. It will be noticed that only the output is used, the NOT output being reformed by NOR gates 10 and 11. The inputs to the storage registers are connected in parallel, the actual selection of the particular store to be used being carried out by apply-

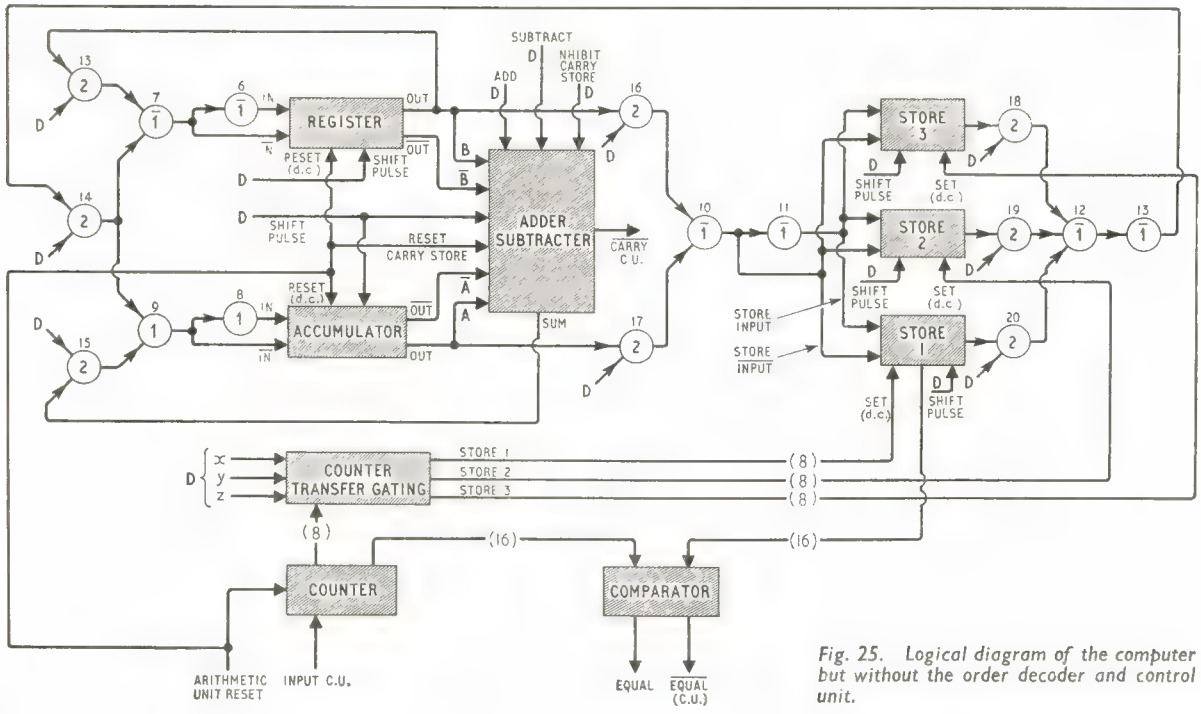


Fig. 25. Logical diagram of the computer but without the order decoder and control unit.

ing shift pulses to the required store only. So with AND 15 closed find AND 17 open, eight shift pulses are applied to the accumulator and store 3. The word that was in the accumulator will now be in store 3.

When this word in store 3 is again required, say in the register, an order is given to the decoder to transfer store 3 to the register. AND gate 13 is closed, closing the register feedback loop, AND gates 14 and 20 are opened and eight shift pulses are applied to the register and store 3. The transfer will have then been carried out.

We have only described two of a possible twelve transfer functions that may be carried out, i.e., the contents of either the register or the accumulator can be transferred to any store, and the contents of any store can be transferred to either the register or the accumulator. As soon as any transfer instruction is ordered both AND gates 13 and 15 close, and not just one of them as was suggested in the two examples given.

It was previously seen that the result of a division is held in the counter. Some means of transferring information from the counter must obviously be introduced. This transfer cannot be a serial one as with a shift register it will therefore have to be a parallel transfer. This means that the contents of the counter will be "copied" into a register. It is arranged that the contents of the counter can be copied into any of the three stores by the network of AND gates shown in Fig. 23. Altogether 24 AND gates are used, divided into three banks of eight. One control line from the decoder (X, Y and Z) is common to each bank of eight. There is one AND gate for each binary position for each store, so the output of each bistable in the counter is connected to three AND gates. When a control line goes "up" the output of each AND gate, associated with that control line, will go "up" if it is connected to a bistable in the counter that holds a binary 1. If the counter held 0 0 0 0 0 0 1 1 and line Y went "up" then the outputs of AND gates 35 and 36 would go "up" to set the 2^1 and 2^0 bistables in store 2. Now store 2 will hold 0 0 0 0 0 0 1 1. Fig. 24 shows the counter transfer gating interconnections. Figures have been used to represent the number of wires to simplify the drawing.

Fig. 25 shows the computer as so far described. All that is required to complete the design is the addition of the order decoder and the control unit. An arithmetic unit reset facility has been added as can be seen from the diagram. This enables the register, accumulator, counter and carry store to be reset on switch on.

(*Next month: design of the control system, by which instructions are given to the computer.*)

POINTS ARISING FROM READERS' ENQUIRIES

The computer has been designed primarily as a teaching aid for use in schools and colleges and is not intended as an operational computer.

If it is desired the word length can be extended to 16 bits by adding extra bistables, no circuit modifications being necessary.

The choice of the term flip-flop was perhaps not a good one; in this series flip-flop refers to a monostable.

The bar over the word output in the fourth line of left hand column, page 371, should be deleted.

The bar across the inputs of the comparator gate (Fig. 8) does not imply that negation takes place within the gate as is confirmed in the circuit of Fig. 9.

MARCONI AIRBORNE COMPUTER

A LARGE number of equipments have in the past been developed for determining the position of an aircraft in flight and for automatically keeping this information up to date. Such equipments have to take into account a large number of variables—wind speed, wind direction, drift, heading, track, air speed, ground speed, etc. If the information is to be presented in terms of latitude and longitude then the equipment must know that the lines of longitude converge towards the polar regions and due allowance made. Another way of presenting information is by means of an imaginary linear grid, the equipment indicating nautical miles flown North/South and East/West of a starting position. Another system sometimes used is known as the along and across track (A/A) method. Here the equipment indicates, as the name suggests, the number of nautical miles flown along a predetermined track and at right angles (across) to that track.

Up until a few years ago, all equipments that performed this task were analogue and the vast majority were almost completely mechanical. The latest generation of machines are digital employing integrated circuits to ensure the reliability and small size essential in airborne equipments, one such equipment, shown for the first time at this year's Paris Air Show, is the Marconi type AD 670 Airborne Computer.

As with all such devices the AD670 computes the aircraft's track (the true direction in which the aircraft is travelling) from the aircraft's compass heading and the drift angle, which in turn depends on wind speed and wind direction. Heading can be obtained from either the aircraft's compass system or from an inertial navigator. Drift is usually obtained from a doppler radar system. This information, together with ground speed, obtained from doppler or the inertial navigator is fed into the computer which in turn drives the output display and, if required, provides guidance information for the automatic pilot.

This task could easily be carried out using a "general purpose" computer which would be more flexible and allow complete reprogramming during flight. Marconi's feel that this facility is seldom required and developed the AD670 which uses only 18% of the storage capacity and 50% of the logic circuitry of a comparable general purpose machine; resulting in increased reliability and a reduction in size, weight and cost.

A converter unit provides the necessary interfaces between the various aircraft equipments and the computer. Up to 32 input/output channels are available. These can be increased if desired by using time sharing techniques on certain channels.

The equipment will provide navigational information in any one of the previously mentioned modes, lat./long., grid, A/A track. In addition it will provide guidance information, either visually or automatically via the automatic pilot, to any predetermined position once the course and distance have been specified. The predetermined position is set in to the computer by punched cards. In all twelve switch-selected, easily replaced cards can be accommodated corresponding to twelve destinations. The equipment will also provide the reference signals (earth and vehicle rates) to correct an inertial platform or a master reference gyro.

The computer may also be used for general flight management monitoring such parameters as fuel flow, engine r.p.m., and temperature, etc. In the event of a power failure an automatic shutdown procedure is initiated, the calculation in hand is completed and all relevant information stored. When the power supply is restored the computer goes through a self check sub-routine and if successful carries on with calculations using information stored before the power failure. It will then be necessary for the human navigator to manually "tell" the equipment the aircrafts' new position.

Colour Tube Production

Deposition and processing of the tri-colour phosphor screens: Assembly and testing of Mazda shadow-mask tubes

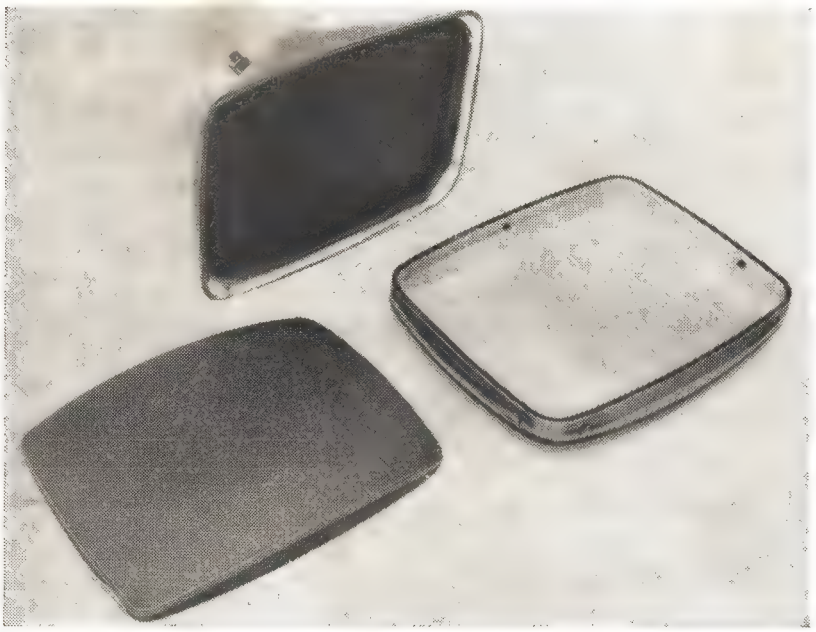
UNTIL recently the shadow-mask cathode-ray tubes* used in British colour television receivers were all imported types or laboratory-made samples. Now, with the B.B.C. well into its "colour launching period," British production lines are beginning to roll. The first colour tube plant to be seen in operation by *Wireless World* is a factory of Thorn-AEI Radio Valves and Tubes Ltd. at Brimsdown, North London. Here the company are producing Mazda 25-inch rectangular shadow-mask tubes, type CTA2550 (A63-11X). The capacity of this plant is over 1,000 tubes per week, but Thorn-AEI point out that it is, in fact, quite a small manufacturing unit as tube factories go. When the demand for colour tubes builds up they will have to open a bigger production plant. At present no 19-inch tubes are being made at Brimsdown, but the company say they are ready to start on this size when there is sufficient demand from the set makers.

First impressions of the Brimsdown factory are that it is largely an assembly plant, since the main components of the product are all bought-in items (actually imported from America). But it soon becomes evident that the most characteristic, and difficult, technique in the production of the colour tube—the laying of the tri-colour fluorescent screen—is a manufacturing process in the full sense of the word, using equipment specially developed by the company and backed by their own R & D effort. By comparison with this the other operations seem relatively straightforward, and in fact, are rather similar to those familiar in the production of monochrome tubes.

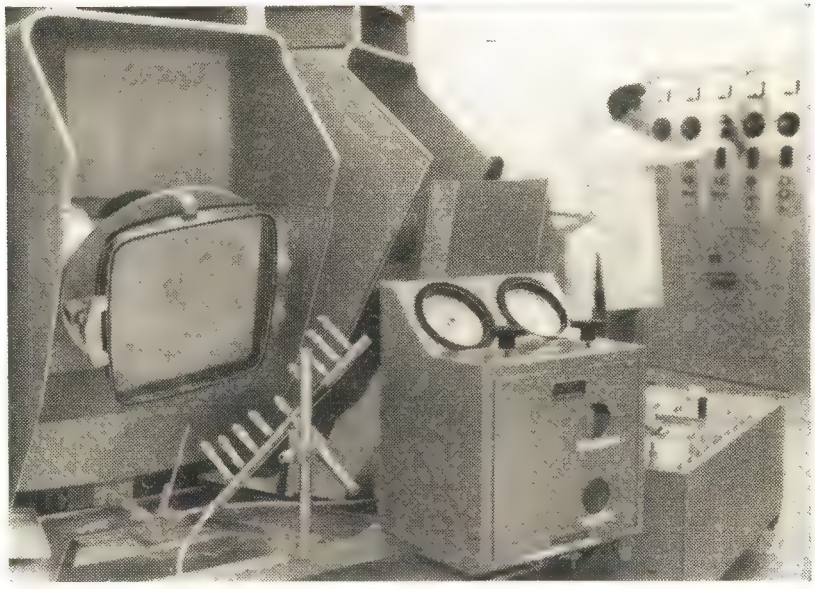
In preparation for screen laying the glass faceplates are washed (in hydrofluoric acid, tap water, and demineralized water), while the steel shadow-masks, which are of flat open-box structure, are cleaned to remove dirt from the perforations and checked for surface uniformity. Since, in the finished tube, the accurate registration of the electron-beam rays with the appropriate phosphor dots depends critically on the screen/shadow-mask geometry, the shadow-mask destined to be sealed into a particular tube must itself be used to determine the positioning of the phosphor dots on the faceplate of that tube. Consequently the faceplate and shadow-mask of a particular tube have to be kept together right through the manufacturing process. The shadow-mask fits inside the faceplate and is secured by springs on its rim which clip on to lugs formed in the glass of the inner surface of the faceplate rim.

Screen laying takes place in a dust-free room with its temperature controlled to $\pm 1°F$ and its humidity to within 2 %. Daylight is excluded since the process is a photo-mechanical one, and the room is lit by fluorescent safelights. Deposition of the phosphor materials on the faceplate is done by three rotary multiple-position machines (one for red, one for green, one for blue), while the photomechanical formation of the dot mosaic takes place on an associated group of photo-exposing machines called "light-houses." First the faceplate is washed with

* For a detailed description of this type of tube, see "A million spots before your eyes," Colour Receiver Techniques Part 3, *Wireless World*, March 1967, p. 106.



The two major glass components—cone and faceplate—and (left) the blackened steel shadow-mask. One of the three locating springs, which clip on to lugs in the inner surface of the faceplate, can be seen on the rim of the shadow-mask.



One of the rotary machines, designed by Thorn-AEI, for the deposition of the three phosphors and subsequent "developing" of the sets of dots after the phosphors have been exposed in the "light-houses."

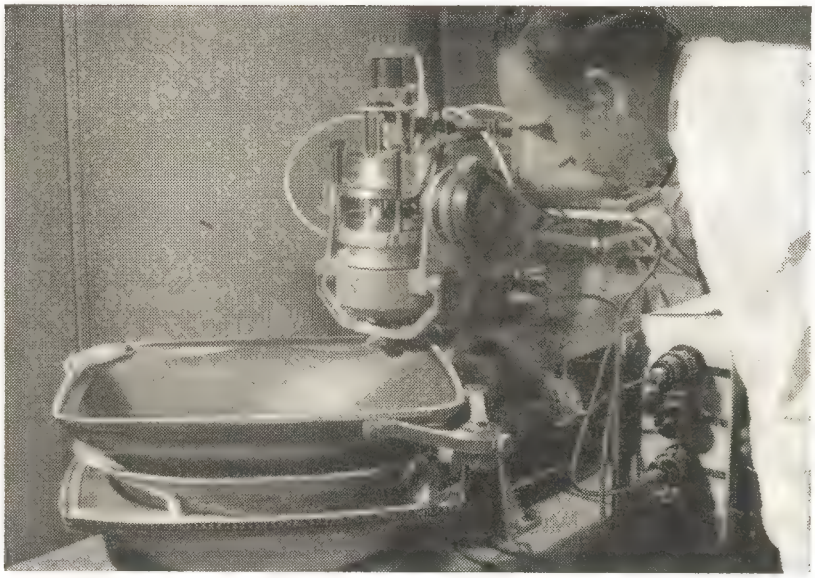
hot water to bring it to the required temperature, then it is mounted in the first of the multiple-position machines, for application of the green phosphor. A measured quantity of the green phosphor material (cadmium zinc sulphide), suspended in a mixture of polyvinyl alcohol, ammonium dichromate and distilled water to form a slurry, is poured into the centre of the faceplate. Then the machine moves the faceplate in a smooth, programmed cycle of tilting and rotation until the whole of the inside surface of the glass is evenly covered. At the next position of the rotary machine the surplus slurry is spun off, and at subsequent positions the deposited layer is dried and cooled for controlled periods. The screen is now ready for the process of forming the green phosphor dots out of the, at present, continuous layer of green phosphor.

First the shadow-mask is fitted into the faceplate, then the assembly is placed on top of one of the "light-houses." At the bottom of the light-house is a 1-kW ultra-violet lamp, the rays from which are directed through a quartz rod shaped to form a small source of u.v. From this small source the u.v. rays pass upwards through the holes in the shadow-mask, which act as pin-hole lenses so that a pattern of u.v. round spots (images of the small source) is thrown on to the phosphor layer. By displacing the u.v. source slightly from the optical centre line of the light-house, and by use of a specially shaped refracting plate interposed in the u.v. path, the u.v. rays are made to simulate exactly the electron rays from the green electron gun in the finished tube. (The only difference being, of course, that the light-house is providing continuous, all-over illumination of the shadow-mask, whereas in an operating tube the electron beam progressively scans its surface. The refraction plate corrects for the effects of all the electron-optical changes that occur during scanning—for example at wide scanning angles.)

Where the green phosphor material is thus exposed to the u.v., the radiant energy polymerizes the polyvinyl alcohol (which has been made sensitive to u.v. by the ammonium dichromate) and so hardens the phosphor material in these exposed areas, leaving the remainder of the material unaffected and soft. After an exposure of several minutes the faceplate is removed from the light-house, the shadow-mask is detached from it and the exposed phosphor is then "developed." This means, in fact, that the screen is washed with demineralized water at a fixed temperature in the multi-position machine. As a result the soft, unexposed areas of phosphor are washed away while the exposed, hardened round spots of green phosphor are left on the screen.

After drying, the whole process is repeated to lay the blue phosphor dots (again basically zinc sulphide), then the red phosphor dots (basically yttrium vanadate). In

Some of the Thorn-AEI designed "light-houses" in which the faceplate, through its shadow-mask, is exposed to ultra-violet light to form the dots on the phosphor.



Automatic application of the sealing compound to the rim of the cone preparatory to the fitting of the faceplate.

each case, of course, the u.v. source in the light-house is suitably displaced from the optical centre-line so that it simulates the appropriate electron gun in the finished tube. Examination of the finished screen under a magnifier, using u.v. to activate the phosphors, shows that the red-green-blue triads are laid extremely accurately, with the sharply defined edges of the circular spots just contiguous and with small uncoated areas of glass between the circles.

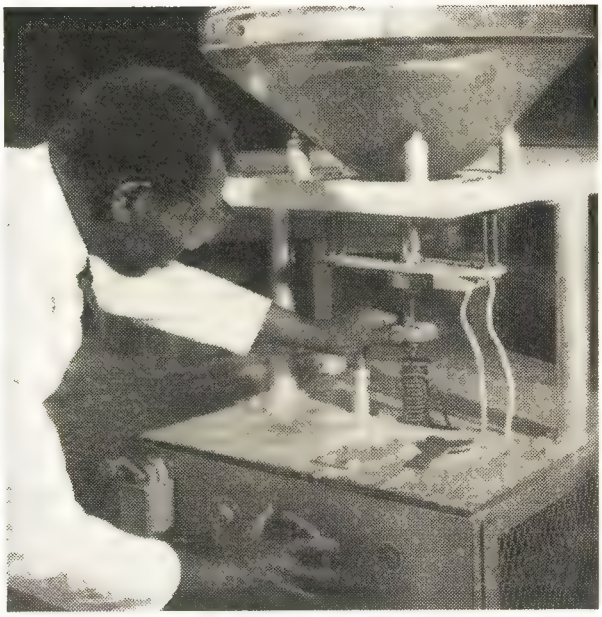
The faceplate, which with its shadow-mask weighs about 23 lb, is aligned with the cone in a jig ready for passing through an oven for heat sealing.

The red phosphor is an exceptionally expensive material and the quantity actually deposited on one screen (forgetting the surplus removed during processing, which is by far the greater part) costs approximately £3. For this reason great care is taken to recover unused material —the normal surplus and other residues from the screen-laying process—and a good deal of plant and R & D apparatus is devoted to this purpose.

The finished screen is taken to another room where it is coated with cellulose and aluminized (the purpose of the cellulose being to provide a good surface for the aluminizing). Next the shadow-mask is fitted back into the faceplate, for the last time, and the gaps between the periphery of the mask and the rim of the faceplate are blocked with thin metal shields attached to the shadow-mask frame. The purpose of these shields is to prevent stray electrons from passing round the outside of the shadow-mask to randomly activate the screen and so cause colour dilution. Spring contacts are welded on to the assembly to connect the screen and shadow-mask to the internal graphite coating of the cone and thence to the e.h.t. stud on the cone.

Meanwhile the cone has been prepared for joining to the faceplate. After being washed it has had an internal coating of graphite applied by spraying and dried by hot air. Next the jointing edge of the cone is chemically cleaned and the cone is placed in a machine which automatically extrudes on to this edge a ribbon of sealing material in paste form. Conventional glass welding cannot be used for joining the cone and faceplate because the high temperatures required might well damage the screen or shadow-mask, so a low-temperature technique using a thermal setting solder (basically lead oxide) is employed for sealing. When this material is heated it forms into a ceramic which bonds with the two glass edges.

For this jointing operation cone and faceplate are put together in specially made jigs. On the rim of the faceplate are three studs formed in the glass which bear on to adjusting screws in the jig, and by means of these screws the faceplate can be accurately positioned on the cone. The now assembled bulbs are passed through an oven on a moving belt, a journey taking some four hours. During this the tubes are heated to 450°C, at which they remain for about an hour, then allowed to cool



A 25-in tube, complete with electron gun, being connected to a vacuum pump.

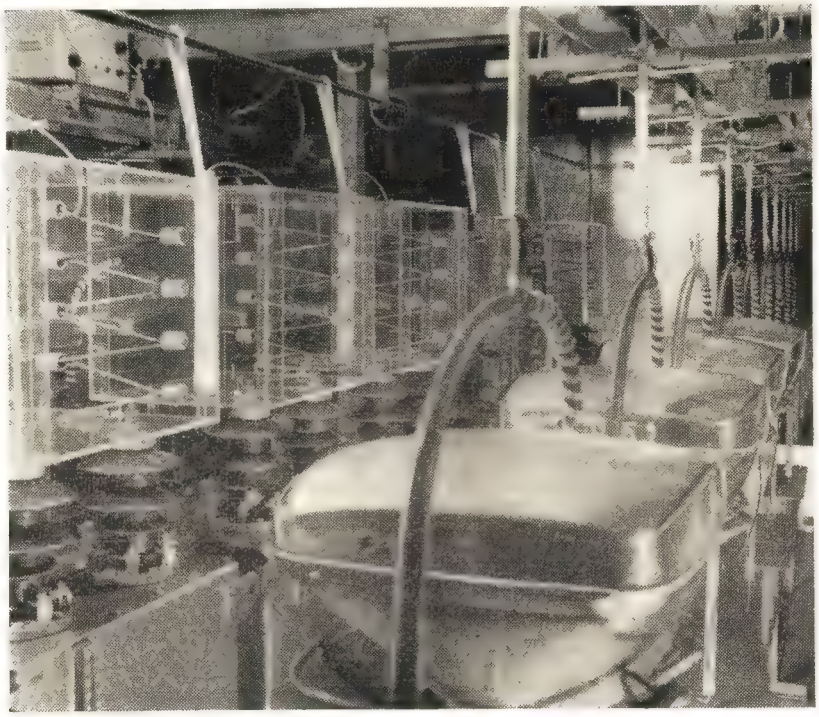
slowly. The ceramic seals so formed are tested by applying a p.d. of 50 kV across them, from the inside to the outside of the tube, and measuring the leakage current, which indicates the existence of any discharges through the material.

Next the triple electron gun is sealed into the neck and the tubes are evacuated and sealed off. These techniques follow conventional practice with monochrome tubes, but a much higher standard of positional accuracy is required to ensure that the three electron guns are correctly aligned with respect to the shadow-mask/screen assembly.

The finishing and testing of the tube is a most comprehensive and exhaustive procedure. First the d.c. characteristics of the electron guns are checked—a procedure which is also used for testing the vacuum by measuring the ion current to one of the tube electrodes. Then the tubes are placed on an overhead conveyor which passes them through a whole series of basic electrical tests and processes, such as heater testing, "spot-knocking" by applying 50 kV to the anode to break down any sharp points on the internal structures likely to cause flash-overs, and ageing and conditioning. Each tube is then taken separately to a console, where deflection and convergence coils are fitted to it and a series of tests on its performance as a colour display device are carried out. These include examination of cross-hatch patterns to check the alignment of the electron-gun/shadow-mask/screen assembly.

A small sample of the tubes produced is put on a life test of 4,000 to 8,000 hours at the maximum voltages and currents that will be met in practice and with scanning applied. During this life test they are switched on and off 12 times a day, the "off" periods being long enough to allow the tubes to cool down completely.

After seeing all the manufacturing processes at Brimsdown—many of which have not been mentioned in this article—one can fully appreciate why colour cathode-ray tubes are so expensive. In fact the retail price of the Mazda 25-inch tube will be "in the region of £90-£100," though, of course, the price to set-makers will be somewhat less than this. Everybody enquires when the price is likely to come down, but there does not seem to be any immediate prospect of this. No doubt we will have to wait until there has been a long run of production at several million tubes a year and all the capital investment and development costs for manufacturing this highly complex new product have been paid off.



Completed tubes in cradles passing through the automatic high-voltage testing plant. The illustration on our front cover shows tubes in another section of the testing chamber.

WORLD OF WIRELESS

New Receiving Licences and Penalties

THE COST of a receiving licence to cover sound radio, colour and monochrome television will be £10 starting on January 1st. This includes a supplementary licence fee of £5 for the reception of colour television. This supplementary licence has been made available since "It is the Government's view, that the cost of colour programmes which are likely at the outset to be available only to a small minority of viewers because of the cost of receivers, should not fall upon viewers in general" (White Paper on Broadcasting December 1966). A special licence for radio and television dealers known as a demonstration licence will cost five shillings, and will be valid for seven years. These licences are restricted to dealers' showrooms only.

Under the Wireless Telegraphy Act 1967—now given Royal Assent—maximum penalties for television licence evasion are raised from £10 to £50 for a first offence and from £50 to £100 for a subsequent offence. By the same Act, the Post Office will require dealers to provide names and addresses of everyone who purchases or rents a television set, new or secondhand, for cash or credit. Dealers may also be asked for names and addresses of those already renting sets. It is stated that last year the loss of revenue due to licence evasion rose to £10M per year.

Anglo-Japanese Electronics Symposium

"A FIRST-CLASS opportunity for an exchange of ideas with Japanese experts at the highest level." These are the words of Sir Robert Watson-Watt, F.R.S., who will lead the British delegation to the three-day electronics symposium in Kyoto, Japan. Of the sixteen papers to be read at this symposium (September 21st-23rd) sponsored by the Electronics Engineering Association and B.N.E.C. Asia, eight will be presented by British companies. Titles will include "Automatic landing, autopilots, flight control systems and navigational aids" from the Aviation Division of Smith's Industries; "Trends and development in maritime radio communications" from Marconi International Marine Co. and "Laser range finder" from G. & E. Bradley. Other companies presenting papers are S.T.C., Elliot Flight Automation, British Aircraft Corporation, Marconi Company, G.E.C. Road Signals, and Decca Radar. The themes chosen for two joint discussions are language communications systems and integrated circuits. The symposium will be followed by the Japanese Electronics Show in Osaka (September 28th to October 4th) which is being organized by the British Embassy.

Computer Languages for Laymen

A PROGRAMME of research into suitable languages for information retrieval from computers has been promoted by the Ministry of Technology. A team working in the mathematics laboratory at the Royal Radar Establishment have undertaken to design computer programmes that allow a wide range of users to communicate directly with their computers without necessarily being skilled programmers. At Malvern, one approach being made to this problem is that of designing programmes which analyse sentences or questions by referring to a pre-arranged vocabulary and a set of grammatical rules. As well as increasing flexibility it allows the user to extend both vocabulary and grammar. Other vocabularies and grammars can be substituted at will, depending upon the particular application. Disc stores will be employed to ensure a rapid response.

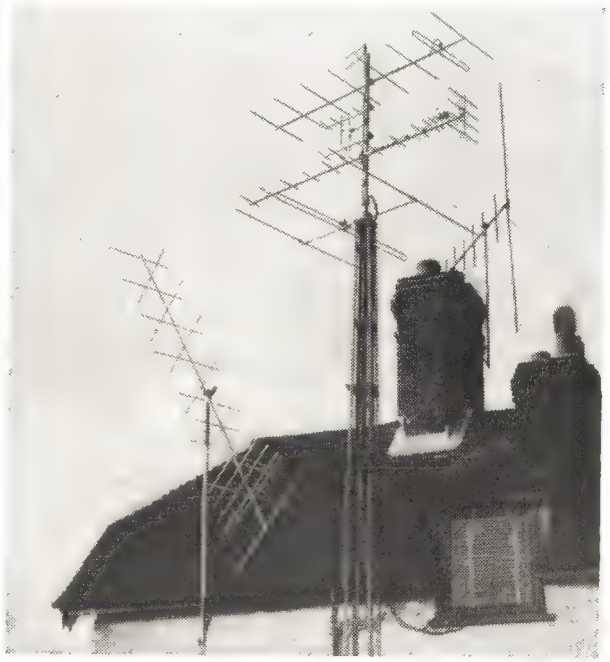
CCTV Network for Schools

ANOTHER education authority is planning a large scale educational television scheme. The borough of Hillingdon in Middlesex is to start experimental transmissions over coaxial links to nine local schools. This is the first stage in the development of a network, which, when completed, will distribute programme material to over 100 schools and to adult education centres in the borough. The studio, equipped with five E.M.I. cameras, will be at the Brunel University, London, W.3. Full sound and vision mixing/switching facilities will also be employed. The university itself will also employ television as a visual teaching aid, and programmes will be relayed to a suite of six lecture theatres. In the May issue it was reported that the Inner London Education Authority are training teachers in television production techniques at the Authority's television centre at Islington; this being the first place in a plan to eventually link 1300 schools and colleges in a television network.

Manx Radio

NOW that the Marine Broadcast Offences Act has been brought into operation we have been asked by the general manager/chief engineer of the Isle of Man Broadcasting Company to clear up any doubts readers may have regarding the legality of its station, especially as it is erroneously listed as "at sea" in our book "Guide to Broadcasting Stations." Operating under the call sign of Manx Radio, this station is licensed by the Postmaster General and operates under a concession agreement with the Isle of Man government.

The aerial array shown here helped the owner R. A. Ham of Storrington, Sussex, to win several contests for logging amateur radio stations. There is an eight element, 2-metre beam at the top of the tower, a three-element four-metre beam and a J-beam X10 which is aligned on the Pole star for radio astronomy work.



Operating frequencies are 1,295 and 1,594 kc/s in the medium-waveband and 89 Mc/s in Band II. Manx Radio is the only local commercial radio station in the United Kingdom. The medium-wave transmitters are at Foxdale, near the centre of the Island, and the v.h.f. transmitters on the top of Snaefell mountain (2,030 ft above sea level).

London Components Show to be International?—The opinion having been expressed in some quarters (including *Wireless World*) that the doors of the R.E.C.M.F. biennial components show should be opened to overseas exhibitors, the Federation is taking a poll among members and exhibitors. The alternatives are (a) restriction, as at present, to U.K. manufacturers or (b) admitting foreign exhibitors and products. Even if proposition (a) is accepted members can state whether or not the present regulations should be relaxed slightly to enable U.K. exhibitors "to display a limited range of foreign products which they offer for sale or intend to manufacture in the U.K."

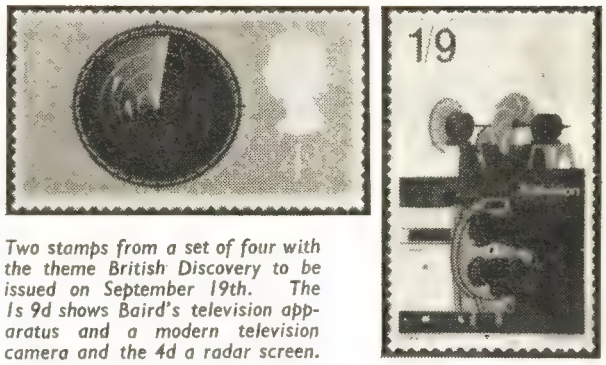
U.H.F. transmitters for 25 stations have been ordered by the I.T.A. These will be employed in the Authority's duplicated 625-line service, and for maximum reliability the transmitters will be installed in pairs, connected in parallel, and automatically controlled. Installation will begin in January 1969, and the first three stations to be equipped under this contract will start monochrome transmissions in the late summer of 1969, going over to colour as soon as possible. The remaining 22 stations will be brought into service successively up to the end of 1971. All the equipment will be used for the transmission of the I.T.A. colour service which is planned to open early in 1970. A contract worth over £2M has been placed with Pye TVT Ltd. of Cambridge for the supply of twelve pairs of 25kW, ten pairs of 10kW, and three pairs of 6.25kW transmitters.

Development of an **East African School of Aviation** has been agreed upon by the United Nations Development Programme's Special Fund and the three governments of Kenya, Uganda and Tanzania. The executive agency will be the International Civil Aviation Organization. Courses to I.C.A.O. standards will be for air traffic control officers, aeronautical telecommunications operations officers and telecommunications engineering officers. Annual total of students is expected to be about 140 to 180 and these students will include those from neighbouring countries as well as holders of I.C.A.O. scholarships.

The first edition of the list of **Space and Radio Astronomy Service Stations** has just been published by the International Telecommunication Union (I.T.U.). Particulars of land, space, and radio astronomy stations are provided in French, English and Spanish in one 70-page volume. The price is 26 Fr. (Swiss) inclusive of surface mail postage, and supplements. Copies are obtainable from the I.T.U., Place des Nations, 1211-Geneva-20, Switzerland.

Silicon transistor tape recorder.—Following publication of the general-purpose class D oscillator design in the August issue (p. 394) the U.K. agents for Bogen heads (Cole Electronics Ltd, Lansdowne Road, Croydon CR92HB) have pointed out that the three heads listed have been superseded. The new types are UL197, UL290 and UL296 which respectively replace UL117, BL210 and BL216. The relation between erase voltage and turns was incorrectly given in the text, and should be $n=V/1{\cdot}3$.

Low-distortion RC Oscillator.—In the article by P. F. Ridler in the August issue the component designations in Fig. 5, the printed board layout, do not correspond with those of Figs. 3 and 4. For correspondence, the subscripts of resistors R_7 to R_{13} should be reduced by one, R_4 should be taken as VR_2, R_{25} as VR_1, R_{26} as R_{23}, C_6 as R_5 and R as R_4. Resistors R_1, R_2, and R_3 are unaffected.



Two stamps from a set of four with the theme British Discovery to be issued on September 19th. The 1s 9d shows Baird's television apparatus and a modern television camera and the 4d a radar screen.

Courses

A bulletin of special courses in **higher technology, management studies** and **commerce** has been published by the London and Home Counties Advisory Council for Technological Education. This bulletin gives details of special advanced courses during 1967/8 which do not regularly appear in college calendars or prospectuses as part of a grouped course, or as subjects offered for endorsement on Higher National Certificates. Copies of the bulletin at 8s 6d may be obtained from the Secretary, Regional Advisory Council, Tavistock House South, Tavistock Square, London, W.C.1.

Post-graduate evening courses starting in the autumn, in the department of electrical engineering, West Ham College of Technology, Romford Road, London, E.15, include integrated circuit application theory, silicon transistor and i.c. technology, semiconductor device theory, and linear circuit theory. There is also a specialist evening course on medical electronics which is open to all working in the medical or biological field, and who require advice and guidance in the use of electronic instrumentation. This course will be conducted at the Medical College of the London Hospital.

Enrolment for part-time day and evening classes at the **Twickenham College of Technology** will take place on the 14th, 15th and 18th September for the 1967/68 year. Full details of fees, and college calendar are included in the prospectus "Department of Engineering 1967/68." Ordinary and Higher National Certificate courses are conducted by the department and among these are electrical engineering, electronic engineering, I.E.R.E., and I.E.E. courses. This prospectus is available from the college at Egerton Road, Twickenham, Middlesex.

Two prospectuses have been received from **Norwood Technical College** for 1967-1968. One is issued by the department of telecommunications and electronics, and includes details of both telecommunications and marine radio courses. The other prospectus is from the science departments and it deals with degree courses and also courses leading to membership of various institutes. Norwood Technical College, Knight's Hill, London, S.E.27.

Computing techniques for industrial application, transistor and transistor circuit design, thyristor applications, and colour television are some of the titles of **short courses** to be conducted during the coming session in the electrical engineering department at Hendon College of Technology, The Burroughs, London, N.W.4.

Details of an evening course for the **L.Inst.P.**. can be obtained from the Head of Science Department, Croydon Technical College, Fairfield, Croydon, Surrey. Three subjects, mathematics, applied physical electronics, and non-destructive testing, each an endorsement to H.N.C. in applied physics, have to be passed within two years.

PERSONALITIES

F. N. Sutherland, C.B.E., F.I.E.E., chairman of The Marconi Company, has been elected chairman of the Conference of the Electronics Industry in succession to the founder chairman, **O. W. Humphreys,** C.B.E., B.Sc., F.I.E.E., F.Inst.P. The Conference (known by the initials C.L.I. to avoid confusion with the Council of Engineering Institutions) was formed in the latter part of 1963 to provide a single, and fully representative organization for the industry. It consists of representatives of the nine principal trade associations representing the various sectional interests of the industry, together with a number of high-level executives from maj r electronics companies. Mr. Sutherland has been the chief executive of The Marconi Company since 1948. He is currently a member of the N.E.D.C. for the Electronics Industry, and of the Postmaster General's Television Advisory Committee, and was president of the Electronic Engineering Association for 1964-65 and of the Royal Television Society for 1965 and 1966.

J. H. H. Merriman, O.B.E., M.Sc., A.Inst.P., F.I.E.E., senior director of engineering in the Post Office, has been elected chairman of the board of the Electronics Division of the I.E.E. Mr. Merriman, who is a physics graduate of King's College, London, obtained his M.Sc. for work on non-linear oscillations. He joined the Post Office Research Station at Dollis Hill in 1936 and was closely associated with the steerable aerial system—M.U.S.A. At the outbreak of the second war he set up and ran radio laboratories at Castleton, near Cardiff. He was appointed an assistant engineer-in-chief in 1963. Mr. Merriman, who is 52, was appointed senior director of engineering (the new Post Office title for engineer-in-chief) a few months ago.

B. H. Venning, B.Sc.(Eng.), Ph.D., M.I.E.E., senior lecturer in the department of electronic engineering at the University of Southampton since 1963, is to be head of the department of electrical & electronic engineering at the Brighton College of Technology. Dr. Venning graduated at the City & Guilds Engineering College (after service in Royal Signals during World War II) and from 1949-52 was at the Admiralty Underwater Weapons Division. He then spent three years as lecturer in electronics at the Manchester College of Technology before joining the staff of the University in 1955.

W. E. Miller, M.A., M.I.E.R.E., has retired after 42 years' association with *Electronic & Electrical Trader* (formerly *Wireless Trader*). After graduating at Peterhouse, Cambridge, and spending a few months with the Cambridge Instrument Company he joined the editorial staff of the *Trader* in 1925. He became technical editor the following year and editor in 1940. In 1962 he succeeded **Hugh S. Pocock** as managing director of Iliffe Electrical Publications Ltd. (which is now Iliffe Technical Publications Ltd.) and for the past few months has been chairman of the company.

E. Eastwood, C.B.E., Ph.D., M.Sc., F.I.E.E., the new chairman of the Control & Automation Division of the I.E.E., has been director of research for the English Electric group of companies since 1962. Dr. Eastwood, who is 57, joined English Electric at the Nelson Research Laboratory, Stafford, where he was in charge of radiation studies, in 1946. He was appointed deputy chief of research with Marconi (a member of the E.E. Group) at Chelmsford in 1948 and subsequently became director of research.

Dr. E. Laverick

Elizabeth Laverick, B.Sc., Ph.D., A.Inst.P., F.I.E.E., head of the Radar Research Laboratory, Elliott Automation Radar Systems Ltd., since 1959, is the first woman to be appointed to a divisional board of the I.E.E. She is among nine ordinary members elected to the Electronics Division board. Dr. Laverick, whose particular field of interest is microwaves and radar, worked for a year at the Radio Research Station, Slough, before going to Durham University in 1943 where she studied physics and radio. She obtained her Ph.D. in 1950 and joined Elliott Brothers (London) Ltd. in 1953. Dr. Laverick is senior vice-president of the Women's Engineering Society.

Colonel Donald McMillan, C.B., O.B.E., B.Sc.(Eng.), F.I.E.E., who is shortly retiring from the Post Office, has been appointed chairman of Cable & Wireless Ltd., and associated companies. Col. McMillan, who is 60, joined the Post Office Radio Section after general engineering training, and in 1931 was posted to the Research Branch, where he concentrated on electro-acoustical problems. In 1952 he took charge of the Engineering Branch and the following year became deputy

F. N. Sutherland

J. H. H. Merriman

Dr. E. Eastwood

Col. D. McMillan

director of the External Telecommunications Executive. Since 1955 he has been director of the Executive and U.K. member of the Commonwealth Telecommunications Board.

Geoffrey G. Gouriet, F.I.E.E., head of the B.B.C. research department, has been elected an ordinary member of the council of the I.E.E. for three years and has also been appointed vice-chairman of the Royal Television Society Council for 1967-8. Mr. Gouriet was head of the Television Group, B.B.C. Research Department from 1950-58. He then joined Wayne Kerr Company as technical director but in 1964 returned to the Corporation to take up his present position.

Alan T. Watts has joined SGS-Fairchild Ltd. as applications engineering manager at their head office at Planar House, Aylesbury. He succeeds **Gordon C. Padwick,** who has joined Fairchild Instrumentation, Mountain View, California, as applications manager. For the past 18 months Mr. Watts has been applications manager in Plessey's semiconductor division. Prior to this he was

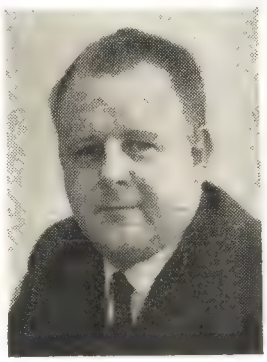
A. T. Watts

for 14 years with Mullard Ltd., of which eight years were spent at the Research Laboratories at Salfords and six years at Mitcham, during which period he became manager of thin film development.

C. H. Robertson, recently appointed by the Marconi International Marine Company as deputy manager, north sea area, served for a time at the Royal Navy Signal School, Devonport, before joining the company as a seagoing radio officer in 1940. He was appointed to the shore staff in 1947 as a technical assistant. In 1959 he became an inspector and since 1964 has been the company's representative at Lowestoft.

E. Newland-Smith has joined the Wyndsor Recording Company as general manager. For the past 10 years he has been with Elizabethan Electronics.

T. M. B. Wright, B.Sc., has joined Cossor Electronics Ltd. as marketing manager of the surface equipment division. After graduating in physics at Reading University in 1950 he joined the scientific branch of the Ministry of



T. M. B. Wright

Supply (Aviation). For most of his ten years in Government service he was at the Royal Radar Establishment but was for two years on the Air Ministry staff in Washington. Mr. Wright, who is 39, was until recently head of systems planning in the satellite communications department of the Plessey Company.

David N. T. Scott, B.A., who joined Rank Bush Murphy Ltd. as marketing manager in 1965, has been appointed a director of the company. A graduate of Trinity College, Cambridge, Mr. Scott, who is 37, was previously with Philips Electrical.

A. S. Banks, formerly works manager of H. W. Sullivan Ltd., has joined Alma Components Ltd. of Diss, Norfolk, as chief engineer. He was with Sullivan for 18 months prior to which he was for nine years with H. Tinsley & Company as general manager. For nine years prior to 1957 Mr. Banks was with Sperry Gyroscope Company as standards engineer on the Blue Streak project.

A. S. Banks

The Société d'Encouragement pour la Recherche et l'Invention recently presented its Ordre du Mérite pour la Recherche et l'Invention to five members of the Institution of Electronic and Radio Engineers. **Earl Mountbatten** of **Burma,** K.G., F.R.S., president of the I.E.R.E. and chairman of the National Electronics Council received the Grande Médaille d'Or in recognition of his support for research. **Leslie H. Bedford,** C.B.E., director of engineering, guided weapons division, B.A.C. (Operating) Ltd. (a past president of the Institution) received the Médaille d'Or "in recognition of his original researches and direction of work in television, radar and guided weapons." Medals were also received by **Graham D. Clifford,** C.M.G., secretary of the I.E.R.E., **Wing Commander Gerald E. Trevains,** of the British Embassy in Paris, and **Paul J. C. Prevost,** secretary of the committee of the Institution's French Section.

B. J. Hadley, B.Sc.(Eng.), who joined International Rectifier Company (Great Britain) in 1962 as production manager, and subsequently became director of production and deputy managing director, has been appointed managing

B. J. Hadley

director. After completing national service with the Royal Air Force, Mr. Hadley, who is 39, studied at Birmingham College of Technology (now the University of Aston) and obtained a London University degree in engineering, specialising in electronics. In 1953 he joined A.E.I. as a graduate apprentice and from 1958-62 was with Texas Instruments latterly as superintendent of planning.

A. G. Emmerton, A.M.I.E.R.E., has been appointed manager of Sierra Leone External Telecommunications Ltd., on secondment from Cable & Wireless Ltd. He began his career in telecommunications with Cable & Wireless in 1943 when he joined the London Training School, and later went to Marconi College. Between 1952 and 1960 he was responsible, as project engineer, for setting up radio stations in Ikoyi (Nigeria), Sitra (Bahrain) and Hiswa (Aden).

TECHNICAL NOTEBOOK

New Approach to Thin-film Circuits

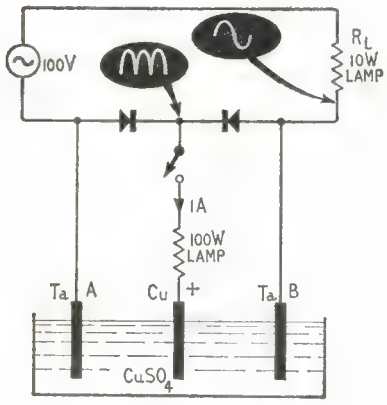
ONE of the major upheavals that integrated circuits are causing is the transference of circuit design from the small equipment manufacturer to integrated circuit manufacturer. This is because expensive capital equipment and complex processes are involved. The screen printing process, though, used for thick film manufacture has a wider appeal but the technique is still involved and will no doubt deter the smaller would-be circuit producers. This situation can be eased by a technique which allows selective etching of multi-layer thin films. The method, which has been developed by the Scientific Instrument Research Association (S.I.R.A.) at Chislehurst, allows the processes of deposition and pattern making to be completely divorced.

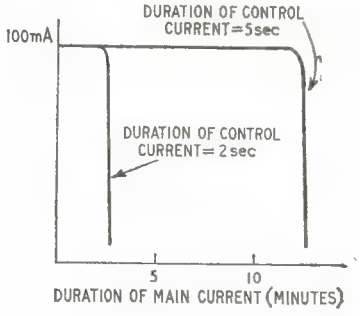
Films are produced with one pumping operation by sequential deposition in a vacuum plant and a typical film order might be: resistor material (Ni-Cr), conductor material (Au), capacitor base plates, bonding layer (Ni-Cr), capacitor dielectric (SiO), bonding layer (Ni-Cr), capacitor top plate (Al). The multilayer film can then be supplied to the user who uses etchants for removing unwanted parts. The layers are photolithographically processed, starting with aluminium, to produce the required pattern on each film. Layers are coated with a photoresist material which is dried, exposed through an appropriate negative, developed and hardened. Unwanted parts of the film are then dissolved with an etchant which dissolves that particular film. After washing, the remaining photoresist is stripped chemically and the process repeated with further films. Various film materials may be used provided, of course, that suitable etchants can be made.

The process is at present used commercially by a number of firms but so far only for two-layer films (resistor and conductor).

Electrochemical A.C. Time Switch

AN electrochemical timing device has been developed which can turn off alternating currents after a prescribed time. The switch depends on transference of a metal through a solution from one electrode to another in much the same way as in electrochemical elapsed time indicators in which mercury is transferred from anode to cathode. The figure shows a simple demonstration set-up in which the cell is formed with 12% copper sulphate solution, two tantalum electrodes and a copper control electrode. The tantalum electrodes are treated by heating to a high temperature (670°C) in order to form an oxide film. With a circuit along the lines of that illustrated and with the control electrode open circuit only a small "leakage" current will flow through the cell. With the control electrode in circuit and at a positive potential copper is transferred to electrode B for positive half cycles and to electrode A for negative half cycles. With this deposition the cell resistance decreases and passes alternating current to the load. The feature of the cell is that if now the control current is switched off, the main current will continue to flow until the copper has been transferred back to the control electrode. The time required for the copper to be returned depends on the amount deposited, which in turn depends on the control electrode current and its duration. The graph shows that for a control current of about 1 A lasting for 5 s, the current through the load (a 10 W lamp) is maintained for about 12 min.





This time switch was developed by Yamaguchi and Ogawa of Yamaguchi University, Japan, and is reported briefly in *Nature* **213** p. 216 (1967).

Germanium for I.Cs

ALTHOUGH mention of integrated circuits almost exclusively implies the use of silicon for active devices, recent work has shown that germanium devices can be developed which enable switching to take place faster than with the present silicon microcircuits. Switching delays of the order of 300 ps have been obtained at the I.B.M. research laboratories.

The circuits are in fact hybrid types, using a ceramic or passive substrate, with thin film nichrome resistors and germanium chip transistors. The transistors, which are only experimental types, are reported to exhibit a cut-off frequency of 6.5 Gc/s and a 5 ps base-collector time constant (base resistance×intrinsic collector capacitance). Low time-constant is given by reducing base resistance, this being more amenable to manipulation than collector capacitance which is usually fixed by device area and operating voltage.

Such circuits have been experimentally developed in the past for linear applications in the microwave region. Texas Instruments, for example, developed a hybrid integrated circuit with germanium chips some time ago. Bell Telephone produced a hybrid 4 Gc/s balanced amplifier also some time ago, this using silicon transistors. Last year, a monolithic microwave circuit was announced by Texas, which was described as a 9 Gc/s transmit-receive switching circuit. The chip measured 0.1×0.1in by 0.01in thick.

Maximum operating frequency of such devices is, of course, limited by the active devices but so far the limits of 9 Gc/s for silicon and 11 Gc/s for germanium (August 1965 issue, p. 417) do not seem to have been exceeded.

INTERNATIONAL BROADCASTING CONVENTION

SEPTEMBER 20th to SEPTEMBER 22nd, 1967

ROYAL LANCASTER HOTEL, LONDON, W.8.

BRITAIN'S PREMIER BROADCASTING EVENT

This Convention combines a high-level Conference of wide and practical scope with an Exhibition, covering some 10,000 sq. ft., of the latest broadcasting and supporting equipment by leading manufacturers.

● **Convention papers include:**

On Colour Television: Colour studio operations practice (United States); Colour film equipment (United Kingdom); Colour production techniques (United States); 4-tube colour cameras (United Kingdom); Colour TV mobile units (United States); Colour recording techniques (United Kingdom).

Other Papers: Planning a TV installation in a developing society (Singapore); Electronic conversion between European and North American television standards (United Kingdom); The design and operation of a complete wired television service (Hongkong); High power UHF television transmitters (United Kingdom); Television presentation suite and its practical experience (Austria); UHF Aerials (United Kingdom); EBU video pre-emphasis standard for television tape recording (Italy); An automated television network switching centre (United States); An electronic system for the control of stage and studio lighting (United Kingdom).

● **An attractive social programme, including a Convention Dinner, a cocktail party and an itinerary of tours and visits of special interest to ladies.**

Convention organised by the Electronic Engineering Association and the Royal Television Society, supported by the I.E.E.E. (U.K. and Republic of Ireland section).

POST THIS SOON FOR FULL DETAILS AND REGISTRATION FORMS

The Convention Secretary, International Broadcasting Convention, Royal Television Society, 166 Shaftesbury Avenue, London, W.C.2.

Please send me full details and registration forms.

NAME .....

Organisation .....

ADDRESS .....

.....

WW—097 FOR FURTHER DETAILS

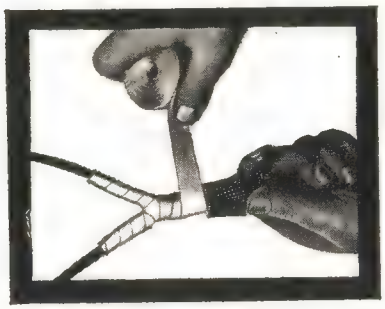
E

HELASHRINK TUBING
HELASHRINK END CAPS
HELASHRINK SLEEVES
HELASHRINK MARKERS

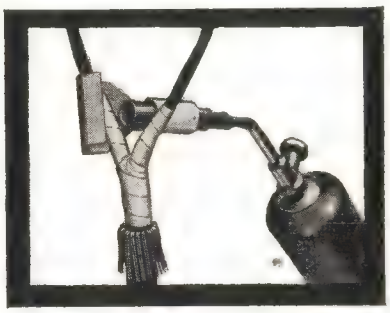
AND NOW

HELASHRINK* TAPE

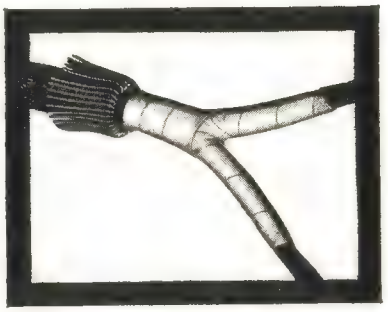
Heat shrinking, multi-purpose insulating tape provides inexpensive airtight and waterproof sealing.



¾" wide tape in 108 ft. rolls (Part No. HTP x ¾"). Adhesive backing "holds" dual thickness tape prior to heating



Heat for a few seconds with a Hellermann Heat Gun — the new Gas Gun is shown here — and the result is instant sealing



Helashrink Tape eliminates the need for expensive 'shapes'. There is now a Helashrink material to cover all applications

Write or phone for leaflet and samples

HELLERMANN ELECTRIC LTD.

World Leaders in Cable Accessories

* *Registered Trade Name*

28

GATWICK ROAD · CRAWLEY · SUSSEX · TELEPHONE: 28888

A member of the Bowthorpe Holdings, Ltd. group of companies

WW—098 FOR FURTHER DETAILS

Tape Pre-amplifier using F.E.T.

Design to eliminate head magnetization and reduce tape noise

By P. F. RIDLER, B.E., M.I.E.E.

TWO main types of transistor tape recorder pre-amplifier have been used in the past. The high-impedance type[1] amplifies the voltage signal from the head and uses feedback to make the input impedance of the amplifier much greater than the impedance of the reproducing head. Equalization may be incorporated into the feedback network or alternatively a flat frequency response amplifier may be followed by a passive equalizer circuit. The low-impedance type of pre-amplifier[2] uses as an input the current output of the head and automatically equalizes the low frequency range, while feedback, or some other means, is used for the high frequency range.

Both types of pre-amplifier have one outstanding disadvantage in that each must feed the signal to the input stage through a blocking capacitor, in order to isolate the bias voltage of the input transistor from the tape head. Under steady state conditions this is easily achieved, but when the amplifier is switched on or off the resulting changes in the bias voltage create a transient current surge through the blocking capacitor which may amount to several hundreds of microamperes, leaving a considerable degree of residual magnetization in the reproducing head.

Any constant magnetization of a reproducing head will not be removed by high frequency bias currents as it would be in a recording head and will cause a serious degradation of the reproduced signal. As the residual magnetization is asymmetrical, (blank) tape noise will no longer average out and there will be a considerable increase in the background noise level, which may be thought of as modulation noise on the zero-frequency signal stored in the tape head. The same asymmetry will also cause distortion of the reproduced signal.

The second effect of head magnetization may be even more serious if the tapes are irreplaceable. The magnetized reproducing head acts as a weak erase head, gradually reducing the higher frequencies recorded on the tape and introducing frequency distortion.

It has been suggested in the past[3] that a direct current which may be adjusted to minimize the noise output from a fully erased tape by demagnetizing the reproducing head is a useful feature of a reproducing system, and in fact this will simultaneously minimize distortion of the signal. The author considers that this facility should be built into any high quality system.

However, it is no use periodically demagnetizing the heads if every time the equipment is switched on or off they are heavily remagnetized, so accordingly a pre-amplifier has been designed which eliminates the blocking capacitor at the input and thus does not magnetize the heads. This simply cannot be done using bipolar transistors as the base of the input transistor requires a bias current and this, because it must not be allowed to flow through the tape head, renders the use of a blocking capacitor mandatory. The field effect transistor, on the other hand, requires only a bias voltage, the gate current being of the order of nanoamperes, and this magnitude of current will not significantly magnetize a tape head. The bias voltage may be obtained from a source resistor in the same way as it would be if a triode valve were being used with a cathode resistor for automatic self bias. This type of biasing system allows both ends of the head to be at (zero frequency) earth potential.

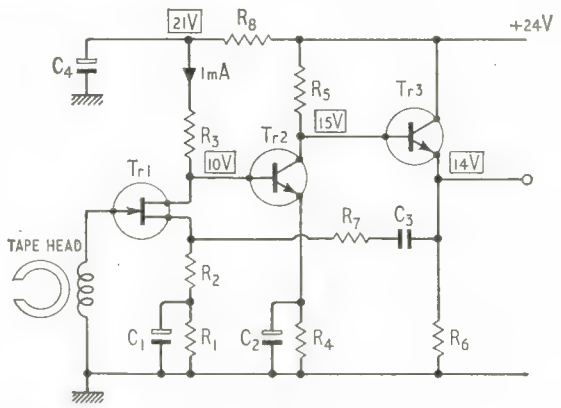


Fig. 1. Circuit of complete pre-amplifier using f.e.t. to avoid head magnetization.

The circuit diagram of the pre-amplifier is shown in Fig. 1, and consists of a 2N3819 f.e.t. (common source mode) feeding a common-emitter connected bipolar transistor. The output is taken from a common collector stage to isolate the amplifier from load variations and also to provide a low-impedance source for the feedback network. The f.e.t. is self biased by means of the by-passed resistor R_1 and the value of this resistor may need some adjusting to bring the drain voltage to within a volt or so of the specified 10 V, as current production low-priced f.e.ts have a fairly wide spread in their characteristics.

The feedback network, C_3R_2 and R_1 gives 100μs C.C.I.R. equalization and the high frequency (3kHz) gain of the amplifier is 50 times more than sufficient to load

COMPONENTS

R_1	330 Ω (see text) 5% high stability	C_1	100 μF 25 V electrolytic
R_2	100 Ω 5% high stability	C_2	50 μF 25 V electrolytic
R_3	12k Ω 5% high stability	C_3	0.02 μF 2% polyester
R_4, R_5	5.6 kΩ 10% composition	C_4	100 μF 25 V electrolytic
R_6	3.3 kΩ 10% composition	C_5, C_6	50 μF 15 V electrolytic
R_7	5 kΩ 2% high stability	Tr 1	2N3819 (Texas)
R_8	2.7 kΩ 10% composition	Tr 2, Tr 3	2N3707 (Texas)
R_9	100 kΩ linear pot.		
R_{10}, R_{11}	10 kΩ 10% composition		
R_{12}	1 MΩ 10% composition		
	All resistors ¼ watt.		

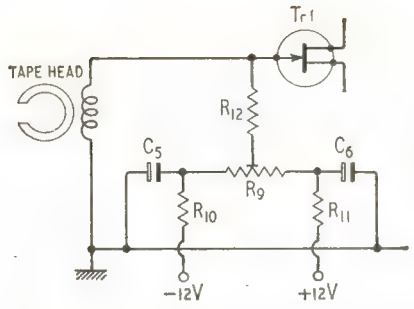


Fig 2. Suggested circuit for d.c. demagnetizing bias to reduce noise output.

fully the high impedance input of most main amplifiers. When the amplifier is used with a medium impedance reproducing head, the noise level is more than 60 dB below a 3% distortion tape signal, and considerably below that of bulk-erased tape. At no time does the direct surge current through the head reach 1 μA and it is probably considerably less than this: it will not magnetize the heads to the extent that the noise level is increased.

Fig. 2 suggests a circuit which will provide a current of between plus and minus 12 μA through the head for noise reduction: this is well worth trying for very high quality reproduction. The current should be adjusted with a bulk-erased tape running through the machine until the tape noise is a minimum. Care should be taken that the two power supplies to the potentiometer turn on at the same rate or it will be necessary to re-adjust the current every time the equipment is switched on. A few trials will show if any alteration is necessary after switching the mains supply on and off once or twice, and if this is so, slight alterations to the filter capacitors C_5 and C_6 will rectify the situation.

REFERENCES

1. High Quality Tape Pre-amplifier, P. F. Ridler. *Wireless World* Feb. 1962.
2. Transistor Tape Pre-amplifier, P. F. Ridler. *Wireless World* Dec. 1958.
3. Adjustments for Obtaining Optimum Performance in Magnetic Recording, A. W. Friend. *R.C.A. Review* Mar. 1950.

BOOKS RECEIVED

How to Build Speaker Enclosures, by Alexis Badmaieff and Don Davis, describes the practical and theoretical "hows" and "whys" of high-performance speaker cabinets. It contains constructional information on the infinite baffle, bass reflex and horn projector types of enclosures and various combinations of these. The book also discusses the advantages and disadvantages of each enclosure type, loudspeakers in general, crossover networks and test methods. Pp. 144. Price 25s. W. Foulsham & Co., Yeovil Rd., Slough, Bucks.

Topology and Matrices in the Solutions of Networks, by F. E. Rogers. This book sets out to explain the principles of systematic methods of solving linear networks; these are based on the fact that the pattern of the Kirchhoff law equations for a linear network is governed solely by its geometric pattern, in the sense conveyed by a topological graph. This is not a text book, but one that seeks to show how to apply these approaches in practice. Pp. 204. Price 27s 6d. Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1.

Electrical Noise, by Robert King. This book discusses the mechanisms that are responsible for noise in electronic circuits together with associated mathematical techniques. After developing expressions for the magnitude of the principle sources of noise generated in thermionic and semiconductor devices, the processing of input noise and the effects of internally generated noise are described. The application of the preceding work in communications is next illustrated and the book ends with a chapter on measuring methods and the facilities available for noise generation. Pp. 195. Price 35s. Chapman and Hall Ltd., 11 New Fetter Lane, London, E.C.4.

Spread-F and its effects upon radiowave propagation and communications, compiled by The Advisory Group for Aerospace Research and Development (AGARD). Initiated in 1961 as part of NATO, it is the function of AGARD to sponsor technical meetings and symposia and the publication of technical papers. The meeting on spread-F irregularities was successful in assembling a large number of specialists in the field and in obtaining a cross-section on classical and new aspects which form the subject matter of this book. The work is divided into four sections which are headed, Spread-F, Scintillation and radio wave propagation, Movements of irregularities and Production of F region irregularities. Pp. 617. Price 105s. Technivision Ltd., Braywick House, Nr. Maidenhead, Berks.

Understanding Telemetry Circuits, by John D. Lenk, provides a non-mathematical introduction to telemetry for intending service technicians. The first chapter discusses the four basic techniques in common use—f.m./f.m., p.a.m., p.d.m., and p.c.m. In the remaining chapters these methods are dealt with in more detail, the various circuits being built up into basic building blocks and the blocks into systems, concluding with a glossary of terms related to telemetry. Although originally intended for the American market a chapter is included for the benefit of the English reader. Pp. 160. Price 25s. W. Foulsham & Co., Yeovil Road, Slough, Bucks.

Proceedings of the Second Lecture Course, Oxford 1966. The series of Oxford Lecture Courses, held annually, is designed to keep engineers abreast with the rapid advances in technology that are taking place in their own and other fields. This book contains nineteen papers on such diverse subjects as microwave generation in solids, electronics in the automobile, semiconductor lasers, advanced computer systems and thermionic power generation. Pp. 142. Price 70s. United Trade Press Ltd., 9 Gough Sq., Fleet Street, London, E.C.4.

Outline of Electronic Circuit Analysis by Andrew R. Cohen. (Pp. 314.)
Outline of Pulse Circuits by Constantine H. Houpis & Jerzy Lubelfeld. (Pp. 319.)
Outline of Electromagnetic Theory by Mathew Zuret. (Pp. 317.)
Outline of Atomic Physics by Solomon E. Liverhunt. (Pp. 315.)
Outline of Fourier Analysis by Hwei P. Hsu. (Pp. 344.)
Outline of Transistor Circuit Analysis by Alfred Gronner. (Pp. 383.)
Outline of Linear Circuits and Systems by Andrew R. Cohen. (Pp. 320.)
Outline of Servo-Mechanisms by Sidney A. Davis. (Pp. 320.)

This series of paper-backed books is of American origin under the Unitech Outline heading. Throughout the series the text covers both well known and new techniques, each subject being approached through basic principles and illustrative step by step worked problems. A good working knowledge of mathematics is assumed. Price 30s each. Distributed by Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1.

Getting the Best Signals into Your Receiver

By T. D. TOWERS,* M.B.E

The design requirements of aerials for colour TV reception and the practical problems of selecting and installing the most suitable type

IN considering what aerial provision to make for a colour television set, the thoughtful engineer will note first that colour transmissions are radiated on the same u.h.f. channels as BBC-2 monochrome (and ultimately also as BBC-1 and ITV when these are duplicated on 625 lines in u.h.f.). In these channels, moreover, the technical requirements for colour and black-and-white are exactly the same. Why, therefore, should not a standard "BBC-2" u.h.f. aerial deal with colour as effectively as black-and-white? The answer is that it will, provided it is correctly selected, designed and installed. The rub is that colour reception is much less tolerant of aerial inefficiencies than black-and-white. This is so true that in some areas an aerial could give an acceptable picture on black-and-white transmission, but when the transmitter switched over to colour the picture would become unusable. That is why the design and installation of aerials for colour television merit special attention.

COLOUR TELEVISION SIGNALS

Sixty-four main stations, with effective radiated powers from 100 to 1,000 kW, will provide colour transmissions in the U.K. in the u.h.f. bands. The table below gives the locations of the first twenty-eight of these u.h.f. television stations with the dates of coming into operation. There will also be low and medium power relay stations associated with the main transmitters to deal with poor reception in "shadow areas.'

Locations of u.h.f. stations in United Kingdom with dates of coming into operation. *(See also August issue p. 378).*

COUNTY	LOCATION	DATE
Anglesey	Llandona	1967
Angus	Balcalk	1969
Bedfordshire	Sandy Heath	1968
Cornwall, East	Caradon Hill	1968
Durham	Pontop Pike	1966
East Lothian	Craigkelly	1968
Flintshire	Moel-Y-Parc	1968
Hampshire, North	—	1969
Ireland, North East	Divis	1967
Ireland, North West	Londonderry	1968
Isle of Wight	Rowridge	1966
Kent	Dover	1967
Kincardineshire	Durris	1967
Lanarkshire	Black Hill	1966
Lancashire	Winter Hill	1965
Leicestershire	Waltham	1967
Lincolnshire, East	Belmont	1966
London	Crystal Palace	1964
Norfolk	Talcolneston	1967
Oxfordshire	Oxford	1967
Somerset	Mendip Forest	1968
Staffordshire	—	1969
Suffolk	Sudbury	1967
Sussex	—	1969
Wales, South	Wenvoe	1965
Warwickshire	Sutton Coldfield	1965
Yorkshire, North	Bilsdale West Moor	1968
Yorkshire, South	Winter Hill	1966

The u.h.f. frequency range used for television lies in two bands between 470 and 854 Mc/s; Band IV=470-582 Mc/s and Band V=614-854 Mc/s. Band IV has 14 channels, numbered 21 to 34, and Band V has 30 channels, numbered 39 to 68. The missing channels 35 to 38 are reserved for non-television purposes. Each station has four channels assigned to it; one for BBC-2 and the other three for other programmes such as the duplication of Band I/III (BBC-1 and ITV) programmes on Band IV/V. As a rule, the station channels are spaced out evenly over an 11-channel-wide spectrum of 88 Mc/s.

Transmission on u.h.f. in Bands IV/V uses 8 Mc/s-bandwidth, 625-line, negative-going vision modulation, with f.m. sound carrier spaced 6 Mc/s from the vision carrier. V.H.F. on Band I/III uses 5 Mc/s-bandwidth, 405-line, positive-going vision modulation, with a.m. sound carrier at 3.5 Mc/s from the vision carrier. This means, of course, that TV receivers and aerials for Band IV/V differ materially from those used for Band I/III.

Band IV/V signal propagation characteristics.—Signal propagation characteristics at u.h.f. differ in some important respects from v.h.f. Firstly, the u.h.f. signal strength at any point is much less predictable. Shifting a u.h.f. aerial a matter of a few inches can produce a large change in signal pick-up, something not common with v.h.f.

The u.h.f. television signal strength tends to fall off with distance beyond the primary service area more rapidly than with a v.h.f. signal of the same field strength. Also, u.h.f. signals tend to be less influenced by the troposphere and ionosphere than v.h.f. Ultra-fringe u.h.f. reception is thus not so common. This, of course, has the advantage that the u.h.f. service areas are much more clearly defined, and you seldom experience in Bands IV/V the summer-time interference between geographically distant stations that occurs regularly on the lower Band-I v.h.f. channels.

Because of their shorter wavelengths, u.h.f. signals are more easily blocked by large buildings, hills, etc., so that "shadow areas" of poor signal strength are more common than in Band I/III. Also u.h.f. signals are reflected more easily than v.h.f. so that double-pictures or "ghosts" are more common. Finally because of the short wavelength, u.h.f. reception is more prone to proximity effects from the chimney or wall on which the aerial is mounted.

*Newmarket Transistors Ltd.

Signal reflection at u.h.f. is not as troublesome as might appear, however, because highly directional aerial arrays are normally used, and in addition reflected u.h.f. signals attenuate more rapidly than v.h.f. before they reach the aerial. Even so, it will still be found that multipath interference tends to be more troublesome in Band IV/V.

If the normal "line-of-sight" computations are carried out, it would seem that u.h.f. reception would be unusual beyond 30-40 miles from the transmitter. However, in Cambridge, at 60 miles from London, I have been able to pick up adequate BBC-2 signals from there as a matter of course.

UHF AERIAL TYPES

The tuned half-wavelength aerial commonly used in television receivers is referred to as a "half-wave" dipole, and in its simplest form takes the shape shown in Fig. 1(a). This elemental dipole, when orientated vertically, responds equally to vertically polarized signals arriving from all directions, and is said to be "omni-directional."

To increase the signal pick-up from any particular direction, a reflector can be attached behind and parallel to the dipole. This leads to the now familiar "H" type aerial commonly used for Band I reception, and is shown diagrammatically in Fig. 1(b) for the vertical polarization common in that band.

In Band III, where the signals may be horizontally or vertically polarized, the aerial elements are much smaller, and parasitic "director" elements are usually attached in front of the dipole (as well as the reflector behind) as shown in Fig. 1(c) for horizontal polarization. This multi-element array is know as a "Yagi" beam.

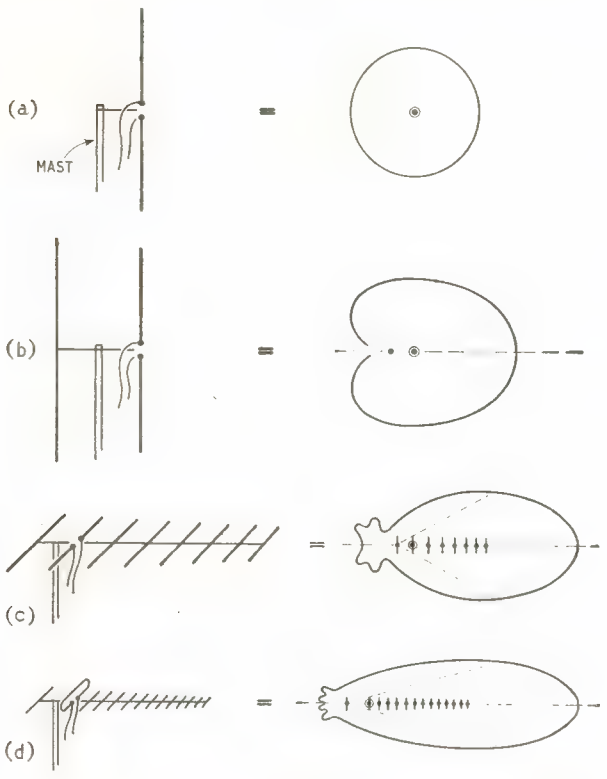


Fig. 1. Various common types of television aerials shown in simplified diagram form with their polar diagrams: (a) simple Band-I dipole, (b) Band-I dipole + reflector, (c) Band-III dipole + reflector + 6 directors, (d) Band IV/V folded dipole + reflector + 12 directors.

In Bands IV and V, the dipole and its parasitic elements are even smaller and the number of directors is usually much greater than in Band III. In addition, the dipole is frequently folded back on itself to make it easier to match the down-lead impedance. A typical u.h.f. aerial is shown diagrammatically in Fig. 1(d), for the horizontal polarization standards in Band IV/V.

As to the actual size of the aerial elements, at the lower frequency end of Band V, the dipole is about 9½ in long and the first director about 8½ in with subsequent directors slightly smaller. The reflector is usually spaced between 0.125 and 0.25 of a wavelength behind the dipole, i.e., a distance of anything from a quarter to a half the full aerial dipole length.

Aerial signal pick-up.—The tuned dipole itself can be as long as 10½ ft in Band I or as short as 7 in in Band V. But for the same pick-up, the total length of all the elements in a television aerial added together tends to be the same in Bands I, III, IV and V. Even so, u.h.f. aerials, although containing about the same amount of metal as v.h.f. aerials, are much more compact and place less strain on their mounting arrangements.

This rule of "equal ironmongery" in all bands is a wide generalization, of course. In applying it you must remember that generally the signal-to-noise ratio of the television sets themselves tends to get worse as the frequency rises. Experience to far has been that on Channel 33, Crystal Palace, around 570 Mc/s, the noise factor of a standard *valve* tuner over the 8 Mc/s channel width is about 2½ times (8dB) worse than around 45Mc/s over the 5 Mc/s bandwith used in Channel 1. With new-generation tuners, which use special u.h.f. transistors, however, the noise performance in Band IV/V is not nearly so much worse than in Band I/III.

Another factor affecting pick-up at u.h.f. is that the signal attenuation in the average length of lead between the aerial and the set is usually about 8dB worse than at v.h.f. for the same cable.

The general conclusion is that, other things equal, more attention must be paid to the aerial in the u.h.f. bands, whether colour or black-and-white is being received, than was necessary in Band I and III.

Polar diagrams.—In Fig. 1 you will also see displayed the polar diagrams of the various aerial types. These indicate how the pick-up of the aerials varies with the direction from which signal is received.

We noted earlier that the simple dipole of Fig. 1(a) is omnidirectional and this gives a circular polar diagram. The addition of the reflector in Fig. 1(b) produces a cardioid, "heart shaped," polar diagram, in which the pick-up from the front is about two times (+3dB) the pick-up from a simple dipole. The pick-up as compared with a simple dipole is usually referred to as the "forward gain" and expressed in dB. Also, as the response from the rear of the aerial is reduced by parasitic elements, the term "front-to-back-ratio" is used as an indication of the maximum-to-minimum response of the aerial. With a dipole-plus-reflector H aerial, a front-to-back ratio of 10dB is typical.

The addition of director elements, as in Figs 1(c) and (d), increases the forward gain, in some designs up to 15 dB total. Similarly, front-to-back ratios can be increased to 25dB. As the number of parasitic elements in the aerial increases, the "directivity" also increases, this is usually specified by an acceptance angle between the two directions at which the forward gain drops to

half the gain along the axis. Acceptance angles as low as 30° are not uncommon in multi-element arrays.

Aerial characteristics.—To simplify comparison of aerials of different makes, manufacturers of u.h.f. aerials have agreed that, whatever form the reflector takes, it should count only as one element, to avoid confusion when stating the number of elements. Some aerials have quite complex multi-rod or net reflectors, which count as only one reflector element. Thus an 18-element u.h.f. aerial comprises a dipole, 16 directors, and 1 reflector, even though the reflector may in fact consist of, say, four separate rods.

The specification of u.h.f. aerials is always made in terms of the three primary parameters: forward gain, directivity and front/back ratio. The forward gain specifies the amount of signal induced across the dipole terminals in a given signal field as compared with the signal that would be induced across the dipole on its own, stripped of the reflector and directors. The directivity expressed as an "acceptance angle" relates to the ability of the aerial to reject signals arriving off-centre. The front/back gain ratio indicates how well the aerial will reject pick-up from the rear, but it also indicates the ability of the aerial to avoid interference from standing waves and proximity effects resulting from the mounting arrangements.

Aerial choice.—The choice of aerial type depends very much on where the receiver is located with reference to the transmitter. A rule of thumb is that the number of elements should not be less than half the distance in miles from the transmitter. In ultra-fringe areas this calls for aerials "stacked," i.e., mounted side by side in parallel. (When two aerials are stacked, about 3dB extra forward gain results.)

I recently carried out a survey of u.h.f. aerials, and, among the eighteen firms in this field, found the greatest number of elements offered in a single u.h.f. aerial was 20.

Aerials now come in three colours: Red=Chs 21-34 (Band IV), Yellow=Chs 39-51 (Band V), Green=Chs 50-66 (Band V), so that the channel group for which the aerial is designed can be immediately seen from the colour code.

In colour television receiver work, the best advice is to use the highest-gain, most efficient aerial practicable in your location. The better the signal you put into the set input terminal, the better will the colour reception be.

UHF AERIAL CONNECTION

Later we will consider the problem of actual aerial installation, but first we will take a look at the factors involved in efficient coupling of the aerial to the receiver.

The signal to be fed to the set is normally taken off from the inner ends of the two halves of the dipole element. Now the dipole possesses impedance, and for maximum transfer of signal from the aerial to the set the down leads should present a good impedance match to the aerial. Mismatch will result in signals being reflected back and forth along the feeder line until lost. Also, part of the incoming signal may be reflected up the feeder from the receiver back to the aerial and down again to arrive after the original signal, giving rise to a fainter displaced image. Finally, the mismatch of the aerial to the feeder may promote a mismatch of the feeder to the television set and lead to u.h.f. tuner instability.

In the past, two forms of feeders have been used for connecting aerials to sets: the coaxial cable ("coax") and the twin feeder. The twin feeder has almost dropped out of use, and nowadays a coaxial cable with a characteristic impedance of about 75 ohms is standard.

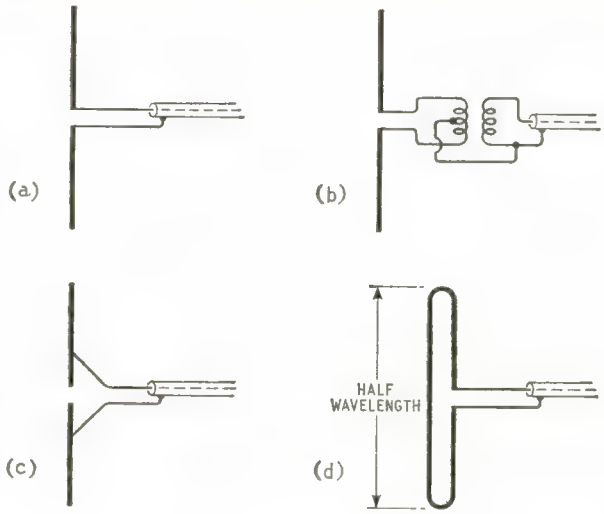


Fig. 2. Connecting a u.h.f. TV aerial dipole to feeder cable: (a) simple dipole unbalanced direct connection to coax lead, (b) "balun" (= balance-to-unbalance) transformer, (c) "delta" match, (d) folded-dipole direct connection.

The half-wave dipole is basically symmetrical, and, to preserve this balance, a twin feeder should theoretically be used, with a balanced input arrangement at the receiver. Experience has shown, however, that even at u.h.f. little trouble is caused by connecting a fundamentally unbalanced coaxial cable direct to a balanced dipole, joining the coaxial centre conductor to one half of the dipole and the earthed outer conducting sheath to the other, as shown diagrammatically in Fig. 2(a).

Coaxial cables cannot be perfectly lossless. The losses that occur in them are measured in dB per 100ft at some specified frequency. Very approximately coax losses increase as the square root of the frequency. Thus a cable with an attenuation of 1.5 dB per 100ft at 45 Mc/s in Channel 1 would probably have an attenuation of 6 dB per 100ft at 720 Mc/s in Channel 52. Therefore a good-quality, low-loss feeder should always be used for a u.h.f. aerial. In fringe and ultra-fringe areas only the best of extra-low-loss coax is advisable.

The output impedance of a simple half-wave dipole in free air is of the order of 75 ohms and admirably matches a 75-ohm coax (if terminated in a 75-ohm characteristic impedance at the set). The addition of directors and a reflector progressively reduces the aerial output impedance until it can fall as low as 10 ohms, which clearly does not make a satisfactory match to 75 ohms. One way of matching the aerial to the feeder is to use a "balun" transformer at the masthead, as shown in Fig. 2(b). This transformer converts from the balanced dipole to the unbalanced coax, and at the same time can convert the impedance appropriately. Another arrangement that has been used is the "delta" match, (Fig. 2(c)) which taps the take-off points on the dipole rods away from the centre, since the impedance rises from a minimum across the centre to a maximum across the ends.

However, by far the commonest way to match a dipole, where its impedance has been unacceptably

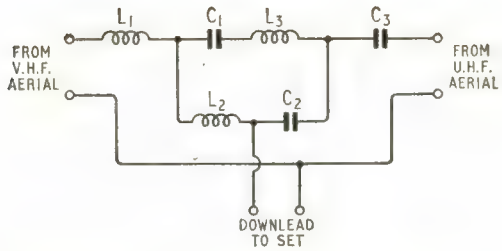


Fig. 3. Combining-unit using low- and high-pass filters to enable u.h.f. and v.h.f. aerials to be fed into common downlead.

lowered by parasitic elements, is to use the "folded" dipole arrangement of Fig. 2(d) feeding directly into the coax feeder. The folding of a full-wave-length aerial to give the same overall half-wave length dipole results in the centre impedance increasing four times in isolation to $4 \times 75 = 300$ ohms. When directors and reflector are then added, the dipole impedance falls, and finally furnishes a good match to the 75-ohm feeder. The folding of a full-wave aerial into a dipole does not materially increase the signal pick-up as compared with the simple half-wave dipole.

Separate u.h.f. and v.h.f. aerials.—In areas where the u.h.f. signal is strong, and a separate u.h.f. aerial is added to the existing v.h.f. aerial array, it is sometimes possible to use the existing v.h.f. feeder to carry the u.h.f. signal as well. A combining unit ("diplexer" or "cross-over unit") is then necessary to enable the two aerials to be fed into the one coax without interfering with each other. Fig. 3 shows a basic circuit of a double-filter network that can be used. If you analyse it, you will see that it represents a low-pass filter accepting the v.h.f. signals from the left and a high-pass filter accepting the u.h.f. signals from the right. At the same time, it presents an all-band rejector network isolating the two aerial inputs. Commercial combining units for this purpose are readily available.

Where the u.h.f. transmissions come in from a station different from the v.h.f. station, a separate differently orientated u.h.f. aerial is normally employed. Ultimately it will be possible in many areas to receive BBC-1, ITV and BBC-2 transmitted from the same site, in which case combined v.h.f./u.h.f. aerials will be usable. Dual-standard sets tend to have separate u.h.f. and v.h.f. input coaxial sockets at present so that separate downleads can be used from the separate u.h.f. and v.h.f. aerials.

Booster amplifiers.—In fringe and ultra-fringe areas, it is commonly necessary to boost the signal with some form of u.h.f. preamplifier. Use of such a "booster" amplifier can give an improvement of signal-to-noise ratio up to 10 dB or so, if the amplifier is mounted at the masthead. However, to avoid the cost of adding the booster amplifier at the masthead on an existing aerial, it is possible to fit it at the bottom of the down lead. This has the disadvantage that spurious signal pick-up in the lead may be amplified. If the booster is masthead mounted, it receives its power along the coax centre lead, with isolating filters to separate the signal and power paths at both ends of the feeder. Booster amplifiers are now usually transistorized, and give a very worthwhile improvement in signal-to-noise ratio. However, they are subject to cross-modulation distortion from two signals arriving together, and it has been found difficult to protect the transistor from failure due to transient voltage "spikes" in thunderstorms.

UHF AERIAL INSTALLATION

Because of the short wavelengths involved in u.h.f. television (from 26 in to 14 in) and because of the high reflectivity of the signals, more care must be exercised in locating the aerial than at v.h.f. U.h.f. aerials must be as high as possible on the chimney or house wall; the higher the aerial, the better the chance of picking up a good signal. It should be located as far as possible from other aerials which may upset its impedance and possibly lead to an apparent change in bandwidth. A common practice is to shift the v.h.f. aerial system into an attic and leave the u.h.f. one clear outside on its own.

Moving a u.h.f. aerial up or down a little, or sideways can lead to very pronounced changes in pick-up; as little as a few inches change can double the signal pick-up.

U.h.f. aerials are more highly directive than v.h.f. and require more careful orientation for optimum signal pick-up and rejection of interference and signal reflections. With v.h.f. receivers, it was often possible to site the array for the best picture quality using the receiver itself as a monitor. With u.h.f. colour, some form of signal strength meter is usually necessary because of the often low signal level and the need to site the aerial for a flat 88 Mc/s bandpass. Good u.h.f. field-strength meters are now readily available commercially.

The problem of optimising aerial arrays in ultra-fringe regions is complex. In Cambridge, where I carried out my experimental work on colour, I used the aerial set-up pictured in Fig. 4, which shows a Labgear U-18 18-element u.h.f. aerial, (15 dB forward gain, 25 dB front/back ratio, 30° acceptance angle) with a Labgear E-5122 u.h.f. masthead transistor amplifier (14 dB gain) all mounted on a Channel-Master "Compass Tenna-Liner" aerial rotator. The assembly was mast-mounted above the roof and clear of all other aerials on my three-storey house. As a result I was able to receive Crystal Palace, Channel 33, from the South at 60 miles and Belmont,

Fig. 4. Author's ultra-fringe, high-gain, rotatable, u.h.f. aerial system (Labgear U-18 aerial and E-5122 booster amplifier, mounted on Channel-Master "Tenna-Liner" rotator).

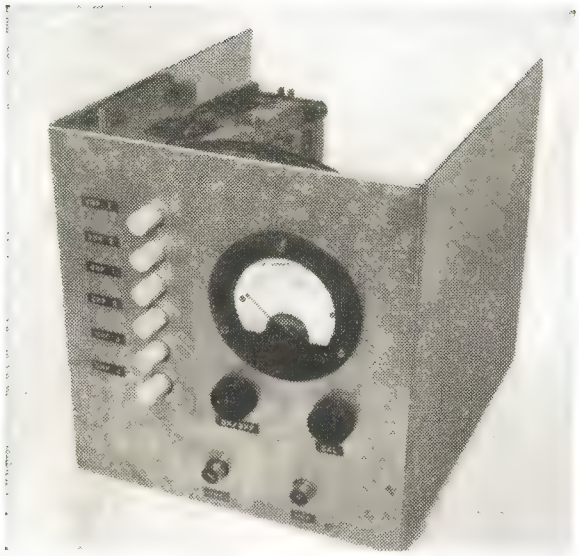


Fig. 5. Field-strength meter assembled by author to ensure optimum aerial location and orientation.

Channel 28, from the North at 80 miles with satisfactory signal strength.

In lining up the aerial system, I used the "do-it-yourself" signal strength meter shown in Fig. 5 which I built around a Pye dual-standard transistorized integrated tuner (just visible on the left in the illustration inside the case). The tuner plus a small mains power pack, a meter and a few bits and pieces gave me an instrument that enabled me to line up my aerial at will on both London and Lincoln.

Alternatives to rooftop Yagi. Although an adequate rooftop assembly must be the first choice for colour television reception, nowadays many housing authorities prevent the use of them. In these circumstances, the viewer may be able to "latch" into one of the efficient communal aerial systems that are being developed to pipe high-quality sound and vision signals to individual dwellings in new housing developments. Where this is not possible, he will have to make do with the best substitute he can find. Near to the transmitter, he can use one of the commercial "set-top" indoor u.h.f. aerials now available. These have the drawback that they require very careful positioning, and the signal pick-up can be affected by people moving nearby. Set-top aerials with inbuilt transistor booster amplifiers are also available, but farther from the transmitter probably the best answer is one of the loft-mounting versions of the standard u.h.f. aerials which are now available.

Loft aerials have the disadvantage that, particularly when the roof is wet, attenuation on the u.h.f. bands may be excessive, and may markedly impair the signal-to-noise ratio of received signals. My experiments with loft-mounted broadside arrays of double 18-element u.h.f. aerials (with a supporting booster amplifier) in an ultra-fringe area suggests that loft-mounted aerials, particularly if amplifier boosted, are usable well beyond the transmitter primary service area.

SUMMARY

Good aerial performance is of vital importance for colour reception on u.h.f. Except close to the transmitter, an outside aerial should be used if possible, to ensure consistently good reception.

A good u.h.f. aerial must have satisfactory forward gain to provide the receiver with adequate signal-to-noise ratio signals to give a good picture at all times. It must also have excellent directivity and front-to-back gain ratio to eliminate unwanted signals and interference from other directions. It must have a bandwidth large enough to receive the four widely separate channels allocated to a transmitter. It must be correctly matched to the downlead for the receiver to reproduce all the signal content fed in by the aerial. Also, it must be mechanically stable so that no trouble in reception can arise from small movements of the aerial as a whole or of the individual elements within the aerial.

Apart from being sufficiently wideband to encompass the four channels spread over 88 Mc/s, the aerial must have constant characteristics across the band, mainly in forward gain, directivity and matching.

The aerial must be mounted in as high and unobstructed position as possible and only the best quality low-loss coax feeder cable should be used to connect it to the set.

There can be no doubt that the aerial is an essential factor in ensuring the benefit of 625 lines and colour available on u.h.f. are fully realized in the television receiver.

CORRECTIONS

"D.C. Power Supplies."—Mullard Ltd. have written to say that in their circuit, reproduced as Fig. 7 in the August issue (p. 377), the 1 kΩ resistor in the cathode of the PD500 performs the function of current monitoring. The feedback for taking care of valve spreads and ageing effects is provided by the circuit configuration. The potential applied to the control grid is determined by the mean load current flowing through the resistor to the stabilized boost potential. Hence the shunt stabilizer maintains a constant load current and the v.d.r. stabilization tends to maintain a constant peak voltage.

"Sorting out the Colour Signals."—The misplacing of a line made nonsense of two sentences in Part 7 of the series (July issue). The top line in the first column of p. 335 should be transferred to the same position on p. 334.

READERS' COMMENTS

In Part 6 (June issue) of his admirable series of articles on colour receiver techniques, Mr. Towers has unfortunately omitted one vital word and may have given rise to misconceptions in the minds of some of his readers.

We refer to the first paragraph on p. 285 in which it is stated "This error signal is applied to the reactance control stage, D, which in turn varies the local oscillator frequency to bring it into step with the *colour burst phase*" (our italics). This, as it stands, is incorrect; the function of the reactance control being to lock the local oscillator frequency to the *mean* colour burst phase.

Confusion is worse confounded by the paragraph on p. 286 entitled "Colour burst phase detector" which not only suffers from the same omission but also introduces the novel concepts of "undirectional a.c." and "the phase of d.c."

H. L. Baker and W. B. Smith

Northwood Hills,
Middx.

Bridge circuit senses motor back-e.m.f. to give closed loop control for model locomotives. The method gives improved performance at low speeds and also enables an indication of armature speed to be given. Unit can be used for any small d.c. motor consuming up to 1A average at up to 12V over a speed range of 40 : 1.

Speed Control for D.C. Model Motors

By H. M. BUTTERWORTH, B.Sc., L.Inst.P.

ALTHOUGH low impedance control units (see the panel) are a great improvement over a simple rheostat for d.c. motor control, they are limited in that they do nothing about winding resistance. When the writer first looked at model power supplies, it appeared that this point was accepted, and that attempts to get round it involved feeding sufficient a.c. to the motor in the hope of rattling the armature over rough spots. This was accomplished either by injecting raw 50c/s a.c. into the drive signal, or by running a switching device at a low enough p.r.f. for some of the a.c. components of the drive signal to get through.

But if we are to really get at the root of the problem, we must get round the winding resistance. One way of doing this is to use an auxiliary circuit which can analyse the voltage appearing at the motor terminals, and develop a voltage which is proportional to the back e.m.f. This voltage can then be compared with a voltage produced by the setting of a potentiometer, and the difference used to drive an amplifier which will drive the motor in such a way as to make the difference small. This, of course, is essentially a servo-control system, which in

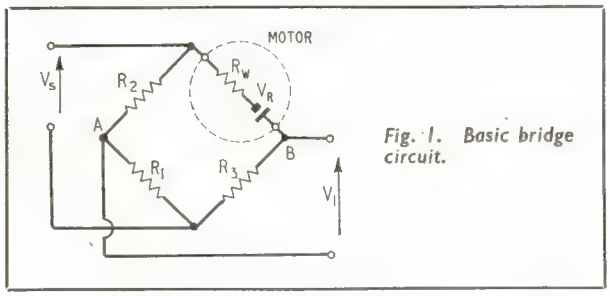


Fig. 1. Basic bridge circuit.

common with all feedback systems is liable to go into oscillation on its own account. Strictly speaking, any such device should be carefully matched to a particular motor, but an arrangement has been devised which, by keeping loop gain low and eliminating all time constants except that of the armature itself, has a reasonable performance when working with most motors in the power range for which it is intended.

H. Butterworth graduated in physics at the University of Bristol in 1961. He then spent three years with a group where he was concerned with the design of high-power industrial ultrasonic equipment and is now designing high-speed electro-mechanical systems.

Bridge circuit. Consider the circuit of Fig. 1. Here the motor is shown as a resistance R_W in series with a voltage V_R, representing the winding resistance and the back e.m.f. respectively. Then if the supply voltage is V_S, the voltage at A is $V_S R_1/(R_1+R_2)$ and the voltage at B is $(V_S-V_R)R_3/(R_3+R_W)$ so the difference between the two is

$$V_1 = V_S\left(\frac{R_1}{R_1+R_2} - \frac{R_3}{R_3+R_W}\right) + \frac{V_R R_3}{R_3+R_W} \quad \ldots\ldots (1)$$

If things are arranged so that the bridge is balanced (i.e $V_1=0$) when the motor is stalled ($V_R=0$) we have

$$\frac{R_1}{R_1+R_2} - \frac{R_3}{R_3+R_W} = 0 \quad \ldots\ldots (2)$$

in which case (1) reduces to

$$V_1 = V_R\frac{R_3}{R_3+R_W} \quad \ldots\ldots (3)$$

Equation 3 is independant of V_S and V_1 is shown to be proportional to V_R, which is exactly what we were looking for. But first we must balance the bridge, and there are two ways in which this can be done. We may either measure the winding resistance and choose suitable values for R_1, R_2 and R_3, or we may make one of these resistors variable and adjust it to make V_1 zero while the armature is held still. This latter arrangement is the

more satisfactory, since the bridge is then readily adapted for any motor.

Tachometer. A voltmeter is needed to detect balance. Once this is established equation 2 is satisfied, and equation 3 holds. The voltmeter then measures a voltage which is proportional to V_R, as shown by equation 3. Since V_R, to within a few per cent, is proportional to the speed of the motor, the meter may be calibrated in rev/min or mile/h. So the voltmeter can be built into the unit and used both to set up the bridge and as a speedometer.

We now have a system which, after a simple adjustment has been made, develops a voltage proportional to V_R. The next step is to compare this with a voltage set up on a potentiometer (which will become the speed control), and to use the error voltage to control the supply to the bridge, and therefore to the motor itself.

Comparator. The voltage V_1 is developed across the bridge, and therefore has no relationship with the supply rails. For the purposes of the motor drive circuit it is necessary to use a comparator so that a voltage can be developed which is proportional to V_1 and which does take its reference from one of the supply rails. This can be achieved with a long-tailed pair circuit. Strictly speaking, we should now use a second similar circuit to compare this voltage with the reference voltage generated by the potentiometer. For present purposes, however, the arrangement shown in Fig. 2 has been found to be adequate, and involves rather fewer components. The reference voltage is developed in RV_3, and for small values it is proportional to the setting of RV_3, which therefore gives us accurate control of motor speed when it is low. For high settings, RV_3 behaves rather like an accelerator control which gives a rather more "realistic feel" for model control, and incidentally reduces the risk of hunting.

The diode D1 and the resistor from the base of Tr1 to the positive rail are introduced to ensure that Tr1 can be switched off and thus prevent "inching" of the motor.

The long-tailed pair has quite sufficient voltage gain

BACKGROUND ON D.C. MOTOR CONTROL

A voltage impressed across the brushes of a small d.c. permanent magnet motor causes a current to flow in the windings, the value of which we may derive by Ohm's Law from the applied voltage and the resistance of the armature winding. If the armature is allowed to rotate, the wires cut the magnetic field, and a voltage (often known as the back e.m.f.) is developed which opposes the applied e.m.f. This means that the voltage across the resistance of the winding must have dropped by the same amount, and so the current flowing must also drop. Since torque developed is proportional to current, the torque is correspondingly reduced. If friction is absent and the motor is entirely unloaded, its speed will rise until eventually the impressed e.m.f. and the back e.m.f. are equal, and the current has fallen to zero.

Any load on the armature causes its speed to fall, so that again current flows. The product of current and back e.m.f. represents the power available to the load, and the motor speed will fall until this power is sufficient to drive the load at a steady speed (assuming, of course, that the load is not excessive). The remainder of the power drawn from the supply is given by the product of the current and the voltage drop across the resistance of the winding and is lost as heat.

We thus can represent such a motor as a resistance in series with a voltage proportional to armature speed (Fig. A). Now, with the motor lightly loaded, the armature speed is such that the applied and back e.m.fs are similar, and so the applied e.m.f. is a good representation

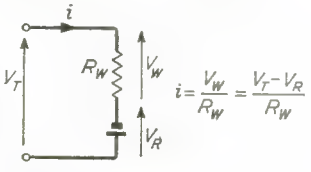


Fig. A. Equivalent circuit of motor showing how armature current is related to applied voltage V_T and induced voltage (back e.m.f.) V_R.

of armature speed. But at low armature speeds or with the armature stalled as when starting from rest, the picture is different. The back e.m.f. is small compared to the voltage across the winding resistance, and so the current flowing changes very little as the armature speed changes. This in turn means that the developed torque remains essentially constant, but the load on the motor under these conditions is usually mainly frictional and liable to vary rapidly over a very wide range. Armature speed, therefore, is controlled by the instantaneous value of frictional resistance to motion, and has no direct relationship with applied voltage.

The "nigger in the woodpile" is, of course, the resistance of the windings, and any increase in circuit resistance contributed by the power supply just makes matters worse. So the usual approach is to drive the motor from a source whose output impedance is low compared to the winding resistance. In general there are two ways of doing this, and both have their advantages.

The first method is to use a compound emitter follower arrangement (Fig. B) containing enough transistors to

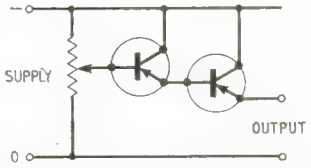


Fig. B. Compound emitter follower. Further transistors may be added if greater impedance transformation is required.

enable a sufficiently low output impedance to be obtained whilst using a high enough value for the resistance of the potentiometer to bring its wattage rating down to a convenient value. Adequate heat sinks must be provided, but excessive currents due to overload or short circuit can be avoided simply by building in sufficient resistance to the primary d.c. source.

In the second type one motor terminal is grounded, and the other is switched between ground and a supply rail by a device whose mark-space ratio can be varied over a wide range. The signal fed to the motor may then be considered as having a d.c. component dependent on the mark-space ratio, and an a.c. component which takes the form of a harmonic series all of whose components have frequencies equal to or greater than the oscillator frequency. This frequency is chosen to be high enough for the reactance of the winding inductance plus the inductance which is the reflection into the circuit of the armature inertia to be large compared to the winding resistance. The part of the equivalent circuit of the armature which involves power (the series combination of winding resistance and back e.m.f.) then merely sees the d.c. component of the drive signal. An example of a design using transistors was given in October 1966 issue of *W.W.*

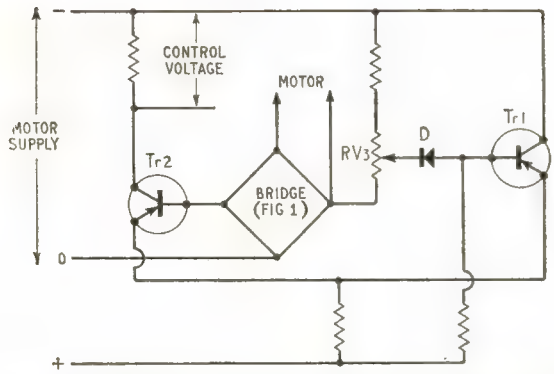


Fig. 2. Comparator circuit using long-tailed pair to compare V_1 with reference voltage from RV_3.

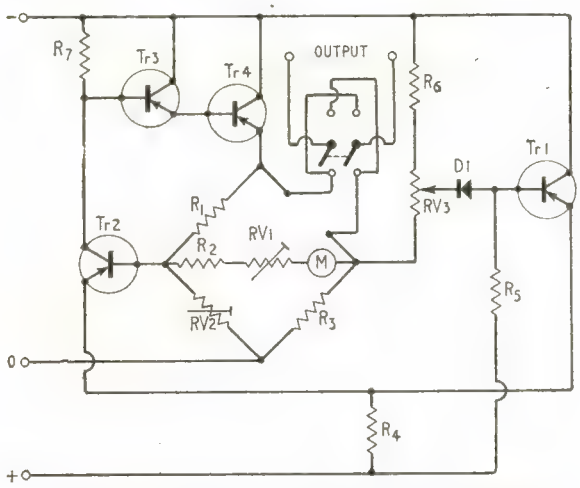
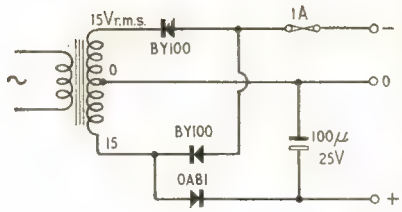
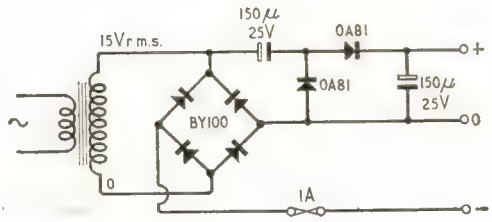


Fig. 3. Final circuit of control unit, less power supply.

for present purposes. We now need an impedance converter to couple its output to the bridge and hence drive the motor. This could be done with a switching amplifier, but it is necessary to be quite sure that none of the a.c. signal gets back into the input of the converter, and this must be accomplished without introducing phase shift into the control loop. Since for small motors there is no great heat dissipation problem for series transistors working in the amplifying mode, there seems little point in using anything other than an emitter follower. A pair of transistors is needed to obtain a high enough impedance transformation, and the circuit, now complete, is as shown in Fig. 3. The transistors may all be OC84 (with Tr3 held in a clip to the chassis as heat sink) except Tr4, which may be any member of the OC28 series, although it should be in reasonable condition, for if it leaks too much when hot it may cause Tr3 to overheat. It should be mounted on a heatsink at least 4in square by $\frac{1}{16}$in thick (aluminium) around which cool air must be able to circulate freely.

Power supply. Suitable power supplies are indicated in Figs. 4 and 5. If a split-phase transformer is available, full wave rectification is accomplished by two diodes such as BY100. A 12 V r.m.s., 1.5 A transformer can be converted for 15 V split phase by re-winding the secondary with the appropriate number of turns (30/12 of the original number, centre tapped) of wire of diameter





Figs. 4 & 5. Alternative circuits for power supply using transformer with either single or centre-tapped secondary. Diodes may be any with minimum ratings of 0·5 A mean current and 50 V reverse voltage.

0.56 of that of the original. The positive voltage for the tail of the differential pair is then developed by an OA81 and a 100 μF, 25 V capacitor. This is shown in Fig. 4. If the transformer cannot be modified a bridge circuit must be used, as in Fig. 5. The rather elaborate circuit necessary to develop the positive supply voltage will be noted.

Some power is lost, as with all transistor power supplies, in the control circuits, and so a 15 V r.m.s. transformer is needed where a 12 V one might have been used with a rheostat. However, as most models manage a scale 150 mile/h or so when driven this way, a 12 V r.m.s. transformer may be found adequate.

It has been found that in practice the omission of smoothing from the negative supply is evident as a somewhat rougher running of the motor at low speeds, but that this is more than compensated for by the effect on friction of the a.c. component at very low speeds. It also saves on expensive components.

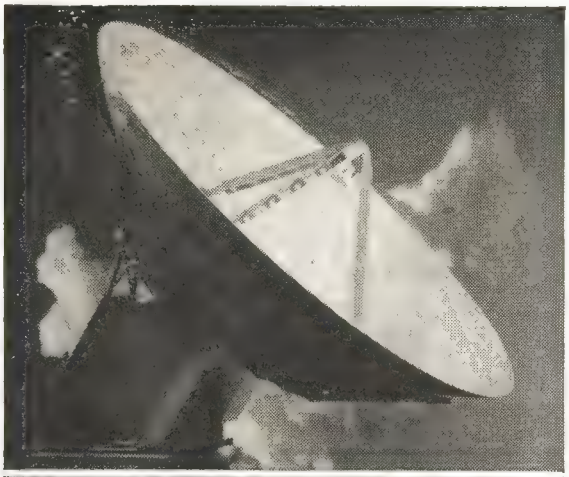
A fuse is incorporated in the circuit diagram. Actually, the circuit will stand occasional short circuit without damage, but Tr4 is liable to get excessively hot if the unit is left with its output short circuited for any length of time. The meter goes hard over under these conditions, and if it is sure to be noticed and the trouble remedied within a reasonable time, the fuse may be discarded.

Setting up. The setting up procedure is as follows. The motor is held so that it cannot rotate, and the speed control advanced sufficiently to enable the meter to be brought to zero using RV_2, which is very quickly done. With three-pole motors it is a good idea to let the armature rotate a little and check the reading in case the brushes had found a rough spot on the commutator. Calibration of the meter, which is adjusted by RV_1, must be carried out by estimating the scale speed of the model and setting RV_1 accordingly. Both these controls must, of course, be set for each motor.

COMPONENTS

R_1	120 Ω	1W	RV_1 2.5 kΩ 1in. carbon
R_2	1.2 kΩ	½W	RV_2 100 Ω w.w. 1W
R_3	4.7 Ω	5W	RV_3 2.5 kΩ 1in. carbon
R_4	2·2 kΩ	½W	Tr1, 2, 3 OC84
R_5	22 kΩ	½W	Tr4 OC28, OC29, OC35,
R_6	2.2 kΩ	½W	OC36.
R_7	2.7 kΩ	½W	D1 OA81

All resistors ±10% tolerance.

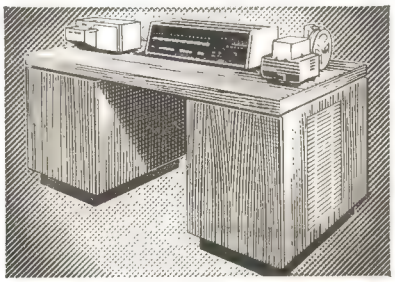


THE QUEEN'S AWARD TO INDUSTRY 1966

Marconi is advanced space communication

Britain's first overseas civil satellite communication ground station has been built by Marconi on Ascension Island for Cable and Wireless Limited. Marconi has also supplied Britain's first three military space communication stations.

Marconi space capability is based on long experience in all the elements required by communication systems via synchronous and random orbit satellites—computers for traffic handling and aerial direction, highly accurate aerial and servo control systems, ultra high frequency transmitters and extremely sensitive receivers. Marconi has a lifelong experience in planning, designing, manufacturing, installing and commissioning complete operational systems anywhere in the world.



Marconi Myriad computer—a vital part of many Marconi space communication systems.

Marconi space communications systems

AN 'ENGLISH ELECTRIC' COMPANY

The Marconi Company Limited, Space Communication Division, Chelmsford, Essex, England LTD/PS1

WW—099 FOR FURTHER DETAILS

The Lilliput Series

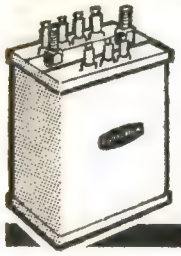
ULTRA MINIATURE, INVERTER, WIDE BAND, CARRIER MATCHING, DRIVER AND PULSE TRANSFORMERS, A.F. AND SMOOTHING INDUCTORS

Gardners Lilliput series of Ultra Miniature transformers has been specifically developed for compatibility with other wired-in modules used on printed circuit boards. Exceptional performance has been achieved by a unique form of construction incorporating extremely thin (down to 3:2 microns) high permeability core materials and a very short length of coil turn. Transformers in this new series are particularly suitable for pulse and switching circuits with rise times of 10 nanoseconds or less

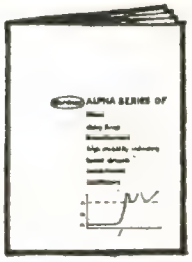
GT12A. Describes the Lilliput series of Ultra Miniature transformers and gives useful information and data on their application in transistor converter/inverter, wide band communication and high speed pulse circuits.

The Alpha Series

FILTERS, DELAY LINES, TRANSFORMERS, MODULATORS, HIGH STABILITY INDUCTORS, TUNED CIRCUITS, OSCILLATORS

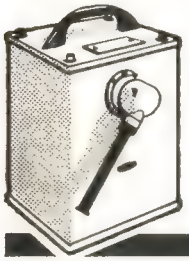


A range of custom built components from simple or hybrid transformers and modulators to highly complex multi-section filters or complete active networks of exceptional stability hermetically sealed to DEF. 5214 Humidity Class H1.

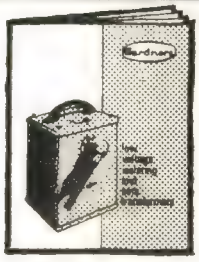


GT16. Gives a general description of the Alpha series assemblies and describes their suitability for wound components where a high degree of stability is required.

Low Voltage Isolating and Auto Transformers



A comprehensive range of conventional double wound and auto transformers for applications in industry and in the home. Nearly 200 types are available in six different styles and with outputs from 6 volts to 240 volts and from 5VA rating to 2 kilowatts. All types are normally held in stock in reasonable quantities for immediate delivery.



GT17. Everyone in the electronics industry uses low voltage, isolating and auto transformers at some time or other and this booklet describes the complete Gardner range of this type of transformer in a convenient and presentable form.

Complete coupon and post indicating publication(s) required ☒

Gardners

Gardners Transformers Ltd., Christchurch, Hampshire
Telephone: Christchurch 1734 Telex 41276

Lilliput Series ☐ Alpha Series ☐
Low Voltage Isolating, Auto Transformers ☐
Name .....
Designation .....
Company .....
Address .....
.....

Standard Frequency Transmissions

Survey of Characteristics of Standard Frequency and Time Signal Stations

By J. McA. STEELE,* B.Sc.(Eng.)

SINCE the publication of the article in *Wireless World* in April 1962 summarizing the characteristics of standard frequency and time signal emissions, the requirements for greater accuracy in frequency determination have resulted in a decided shift in emphasis away from the high frequencies towards the use of low- and very-low frequencies where propagation is sufficiently stable and reproducible to permit frequency comparisons of the highest precision. At v.l.f. a comparison accuracy of one or two parts in 10^{11} can be achieved over 24 hours at ranges up to 10,000 km, using frequencies in the range 15 to 25 kHz. At shorter ranges the l.f. band is being increasingly used for the dissemination of both time and frequency and does not suffer from the limitations of mutual interference and varying propagation which beset high frequencies. There are now stations in operation on 40, 50, 60, 75, 77·5 and 80 kHz and in addition two European broadcasting stations—Allouis (164 kHz) and Motala (191 kHz)—following the example of Droitwich (200 kHz), now operate with precisely controlled carrier frequencies.

It is encouraging that many of the stations in the l.f. band radiate frequencies adjusted to nominal in the atomic scale and without the fractional frequency offset which is applied to all controlled emissions at v.l.f. The question of the offset is considered in more detail later but briefly it accommodates the present difference between the scale of atomic time and the scale of Universal Time (UT2) based on the Earth's period of axial rotation. The extent of the offset is subject to annual review and in the past changes in the offset have been a source of inconvenience to users of the standard frequency services. Atomic frequency standards are now available commercially from several sources and a number of the stations listed in Table 1 are controlled either directly or indirectly by reference to an atomic generator. This is particularly appropriate at l.f. and v.l.f. and also at very high frequencies where the stability of propagation is well matched to the frequency stability of the controlling standard.

HIGH-FREQUENCY EMISSIONS

In the h.f. band the frequencies of 2·5, 5, 10, 15, 20 and 25 MHz are allocated internationally to the standard frequency services. They may also be used by the radio astronomy service and in addition the bands 10·003-10.005 and 19.990-20.000 MHz are available on a secondary basis to the space and earth-space services for research purposes. Despite the extension of controlled frequency emissions to both higher (v.h.f.) and lower (l.f. and v.l.f.) frequencies, the h.f. band continues to provide a widely used service of time and frequency reference. It is true to say that with the increasing standard of accuracy required in industry and research the h.f. carrier frequencies are now less useful since the signal is usually received after reflection in the ionosphere and Doppler effects restrict the stability to, at best, one or two parts in 10^8, while variations ten times as great may be experienced at sunrise and sunset. Where the local frequency source can be operated as a clock the use of the time signals enables the diurnal and Doppler effects to be largely eliminated by extending measurements over 24 hours. The limiting accuracy in time setting is then governed by other factors such as multi-path propagation and selective fading of the sidebands of the modulated signals. The h.f. stations will continue to provide a satisfactory service of time signal dissemination to an accuracy of a few tenths of a millisecond although in the absence of firm time or frequency sharing arrangements the usefulness of the service will still be impaired in certain areas by mutual interference between stations.

In Table 1 are given the characteristics of 15 stations, operating either with single or multiple emissions on the allocated frequencies in the range 2.5 to 25 MHz. Also included by reason of their general usefulness are the stations CHU (Ottawa) and DIZ (Nauen) both of which provide a continuous emission of time signals at intermediate frequencies. The Table is confined to those stations operating with stabilized carrier frequencies which are coherent with the time signals or, at least, remain in a known relationship with the phase of the time signals. There are many other time signal emissions with unstabilized carrier frequencies which this article does not attempt to cover. For the schedules of these emissions the appropriate publications of the Bureau International de l'Heure (B.I.H.) or the International Telecommunication Union (I.T.U.) should be consulted. It will be noted in Table 1 that the majority of stations operate with an aerial power of a few kilowatts and it is an advantage of h.f. propagation that such modest powers provide wide coverage. It should be noticed also that WWV is now located at Fort Collins, Colorado, and that reception in Europe is likely to be less certain than when the transmitters are operating from Beltsville, Maryland.

The information in Table 1 is supplemented by details of the hourly modulation schedule, presented in schematic form in Fig. 1 and showing the sequence of alternating periods of tone or pulse modulation. The form and content of the station announcements and the type of time signal modulation are also described. One of the past recommendations of the International Radio Consultative Committee (C.C.I.R.) was that modulated time signals should take the form of m cycles of $200\,m$ Hz ("where m is an integral number limited by the bandwidths allotted for standard-frequency transmissions and time signals") thereby producing a pulse of constant

* National Physical Laboratory, Teddington

TABLE 1

Schedule of standard frequency and time signal stations in the h.f. band at June 1967

Call sign and approximate location		ATA Kalkaji, Delhi, India	BPV Shanghai, China	CHU Ottawa, Canada	DIZ Nauen, German D. Rep.	FFH Chevannes, France	IAM Rome, Italy	IBF Turin, Italy	JJY Tokyo, Japan	LOL Buenos Aires, Argentina	MSF Rugby, U.K.	OMA Liblice, Czechoslovakia	RWM-RAT Moscow, U.S.S.R.	WWV Ft. Collins, U.S.A.	WWVH Hawaii, U.S.A.	ZLFS Lower Hutt, N. Zealand	ZUO Olifantsfontein, S. Africa	ZUO Johannesburg, S. Africa
Latitude Longitude		28° 34′N 77° 19′E	31° 12′N 121° 26′E	45° 18′N 75° 55′W	52° 39′N 12° 55′E	48° 32′N 2° 27′E	41° 52′N 12° 27′E	45° 02′N 7° 42′E	35° 42′N 139° 31′E	34° 37′N 58° 21′W	52° 22′N 1° 11′W	50° 04′N 14° 53′E	55° 45′N 37° 18′E	40° 41′N 105° 02′W	20° 46′N 156° 28′W	41° 14′S 174° 55′E	25° 58′S 28° 14′E	26° 11′S 28° 04′E
Carrier power to aerial (kW)		2	—	0.3, 3, 5	5	5	1	5	2	2	0.5	1	20	2.5, 10	2	0.3	4	0.25
Frequencies used	Carrier (MHz)	10	5, 10, 15	3.330, 7.335, 14.670	4.525	2.5	5	5	2.5, 5, 10, 15	5, 10, 15	2.5, 5, 10	2.5	2.5, 5, 10, 15	2.5, 5, 10, 15, 20, 25	2.5, 5, 10, 15	2.5	5	10
	Modulation (Hz)	1, 1000	1, 1000	1	1	1, 1000	1, 1000	1	1, 1000	1, 440, 1000	1	1, 1000	1, 1000	1, 440, 600	1, 440, 600	Nil	1	1
Period of operation	Days per week	Mon.-Fri.	7	7	7	Mon.-Fri.	Mon.-Sat.	7	7	Mon.-Sat.	7	7	7	7	7	Tues.	7	7
	Hours per day*	05.30-07.30	24	24	24	08.00 16.25	07.30-08.30	†	24	§	24	24	‡	24	24	01.00-04.00	24	24
Accuracy of frequency and time intervals¶ (parts in 10^{10})		±200	—	±1	±50	±2	±1	±1 not offset	±1	±10	±1 not offset	±10	±50	±0.5	±1	±10	±1 not offset	

TABLE 2

Schedule of standard frequency and time signal stations in the l.f. and v.l.f. bands at June 1967 (excluding navigational stations)

Call sign and approximate location		GBR Rugby U.K.	NAA Cutler Maine U.S.A.	NCK/NPG Jim Creek Washington U.S.A.	WWVL Ft. Collins Colorado U.S.A.	NSS Annapolis Maryland U.S.A.	NPM Lualualei Hawaii U.S.A.	NBA Balboa C.Z. U.S.A.	JJM-6/ JG2AS Kemigawa Japan	OMA Liblice Czechoslovakia	MSF Rugby U.K.	WWVB Ft. Collins Colorado U.S.A.	HBG Prangins Switzerland	DFC77 Mainflingen G.F. Rep.	CYZ40 Ottawa Canada	RES Moscow U.S.S.R.	Allouis France	Motala Sweden	Droitwich U.K.
Latitude Longitude		52° 22′N 01° 11′W	44° 39′N 67° 17′W	48° 12′N 121° 55′W	40° 41′N 105° 03′W	38° 59′N 76° 27′W	21° 25′N 158° 09′W	09° 04′N 79° 39′W	35° 38′N 140° 04′E	50° 04′N 14° 53′E	52° 22′N 01° 11′W	40° 41′N 105° 03′W	46° 24′N 06° 15′E	50° 01′N 09° 00′E	45° 21′N 75° 53′W	55° 45′N 37° 18′E	47° 10′N 02° 12′E	58° 26′N 14° 12′E	52° 18′N 02° 06′W
Carrier power (kW)	to aerial								10	5	10		25	12		20	500	600	400
	radiated	60	1000	250	1.7	85	300	150				7			0.4				
Standard frequencies used	Carrier (kHz)	16.0 (15.95)	17.8	18.6	20.0 19.9	21.4	23.4	24.0	40	50	60	60	75	77.5	80	100	164	191	200
	Modulation (Hz)	1	nil	nil	nil	1	nil	1	nil	1	1	1	1	1 200 440	nil	1	A3 broadcast		
Period of operation	Days per wk.	7	7	7	7	7	7	7	7	7	7	7	7	Mon-Sat.	7	7	7	7	7
	Hours per day	24	24	24	24	24	24	24	24	24	24	24	24	5½	24	24	24	24	22
Duration of time signal emission (minutes)		4 × 5 (2)	nil	nil	nil	55-60 in each hour	nil	55-60 in each hour (3)	nil	23 hours per day (4)	cont.	cont.	cont.	(5)	nil	55-60 in each hour (6)	nil	nil	nil
Accuracy of (1) frequency and time intervals (parts in 10^{10})		±1	±0.5	±0.5	±0.2	±0.5	±0.5	±0.5	±0.5	±10	±1 not offset	±0.2 not offset	±0.2 not offset	±5 not offset	±1	±50	±0.5 not offset	±2 not offset	±5 not offset

FOOTNOTES TO TABLE 1

* All times are G.M.T. The hourly modulation schedule is given in schematic form, where appropriate, in Fig. 1.

† IBF operates from 06.45-07.00 and for 15 minutes preceding the hours 09.00, 10.00, 11.00, etc., until 18.00.

§ LOL transmits for one hour at 11.00, 14.00, 17.00, 20.00 and 23.00.

‡ RWM-RAT follows a variable schedule on one or other of the frequencies indicated; examples of the programme are given in the text.

¶ All the stations in the Table, with the exception of BPV and RWM-RAT, attempt to maintain their time signals in agreement to within about 1 ms with the international co-ordinated time scale U.T.C. The rate of the time signals differs from that of a clock keeping atomic time by the amount of the frequency offset which is announced for each year by the Bureau International de l'Heure (B.I.H.). For 1967 the offset is 300 parts in 10^{10}, equivalent to 2.592 ms per day. The carrier frequencies of nearly all h.f. stations are offset from nominal by this amount and the figures for accuracy given in the Table are therefore with respect to the offset value. The exceptions to this practice are IBF, MSF and ZUO; these emissions operate with the carrier frequencies adjusted to nominal in the atomic scale and zero offset. The time signals, however, continue to adhere to the co-ordinated system, U.T.C., a suitable time scale conversion being introduced at the transmitter between the carrier and time signal generators.

FOOTNOTES TO TABLE 2

(1) The same distinctions in regard to accuracy apply as detailed in footnote ¶ to Table 1. Nearly all stations attempt to maintain their time signals in agreement to within about 1 ms with the international co-ordinated time scale U.T.C. The exceptions are WWVB, DCF77 and RES. No offset is applied to either the carrier frequency or the time signals of WWVB and DCF77. These two stations co-ordinate the times of emission of their signals to within 1 ms and adjustments are made simultaneously, when necessary, in steps of 200 ms. These are the only stations at present transmitting seconds pulses; in all other emissions the interval between 'seconds' signals is greater at present than one second by the amount of the offset.

(2) Time signals are radiated for 5 minutes preceding the hours 03.00, 09.00, 15.00 and 21.00 U.T.

(3) Except 23.55 to 24.00 U.T.

(4) Unmodulated carrier between 10.00 and 11.00 U.T. except for the call sign OMA at the beginning of each quarter hour.

(5) (Atomic) seconds pulses controlled by the Physikalisch-Technische Bundesanstalt (PTB) from 07.45-07.59, 08.30-10.59, 11.30-11.35, 20.11-20.29, 20.41-20.59 and then at 57-59 minutes in each hour until 00.57-00.59 (November to February) or 02.57-02.59 (March to October). 440 Hz modulation at 08.11-08.29 and 200 Hz modulation from 11.11-11.29.

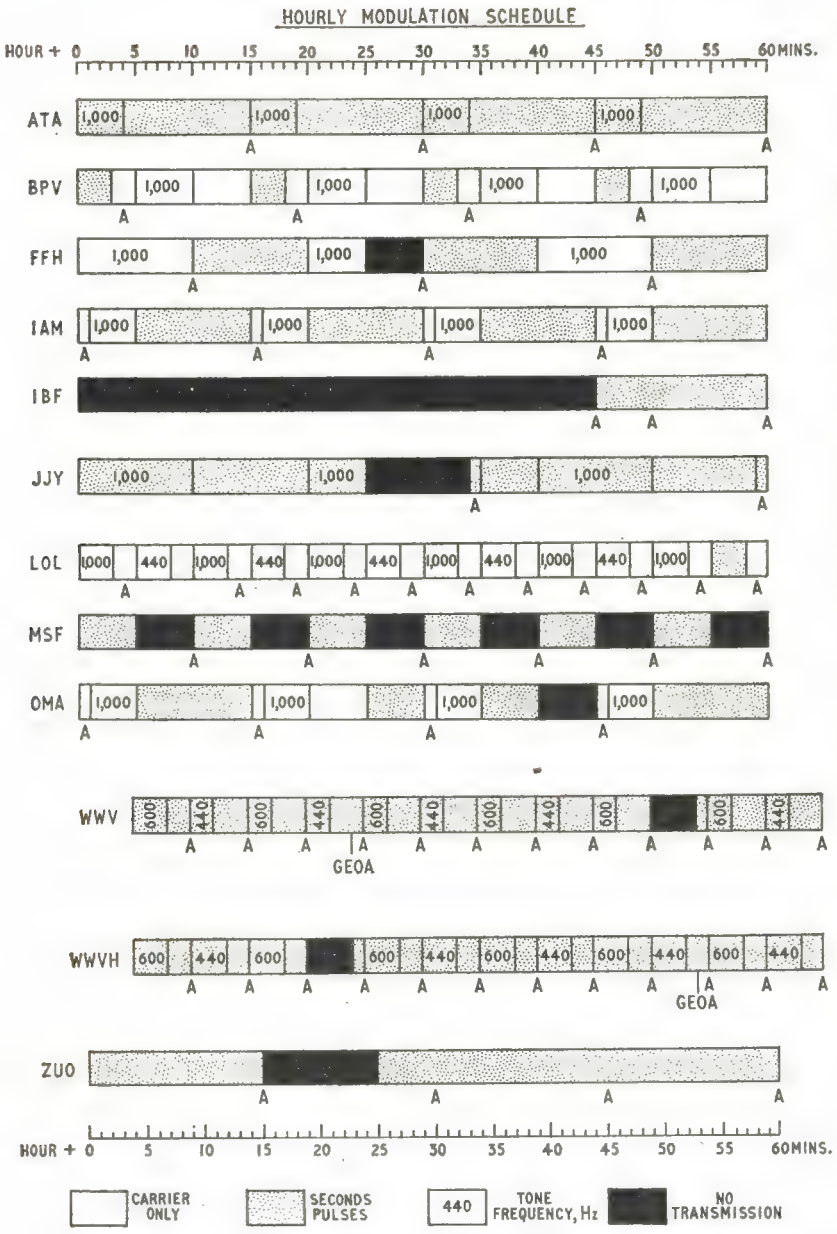
(6) Except 19.55-20.00 U.T.

length equal to 5 cycles. In practice, as Fig. 1 shows, a pulse consisting of 5 cycles of 1,000 Hz is used by the majority of emissions. However, the system constitutes a useful method of discriminating between potentially interfering emissions and finds satisfactory application in the Pacific area where WWVH makes use of a signal consisting of 6 cycles of 1,200 Hz tone while JJY uses a signal consisting of 8 cycles of 1,600 Hz. Pulses departing from the C.C.I.R. formula are radiated by stations BPV, CHU, DIZ and RWM-RAT, all of which make use of considerably longer signals. The seconds pulses of CHU last for 200 cycles of 1,000 Hz, extended to 500 cycles at the minutes and to 1,000 cycles at the hours. Each minute pulse is preceded by a voice announcement of the time in minutes and hours. Further time identification is provided by omitting the pulse at minute 29 and from minutes 51 to 59; the pulses from minutes 1 to 10 in each hour are also suppressed. Station DIZ emits telegraphy signals lasting 100 ms at the seconds and about 600 ms at the minutes. The emissions of RWM-RAT also make use of telegraphy signals and include short periods when rhythmic (61/minute) seconds are broadcast as well as standard 1 Hz and 10 Hz pulses. The rhythmic seconds are radiated in minutes 0-6 after each even hour (U.T.). Seconds signals, 100 ms long, are emitted in minutes 20-25, 30-35 and 50-55 in each hour, the minute pulse being lengthened to about 500 ms. Seconds pulses are also radiated in minutes 25-30, 35-40 and 55-60 in each hour. In these periods the minute is not identified and each seconds pulse is followed 200 ms later by a train of 8 pulses, 20 ms long and spaced 100 ms apart. In the intervals between pulse transmissions there are periods of unmodulated carrier, the carrier frequencies in use throughout the day being chosen to ensure the most favourable propagation.

The same basic schedule of pulse transmission of RMW-RAT is followed by other Russian stations operating either at the same carrier frequencies or at frequencies staggered 4 kHz above and below the nominal values. The details are as follows:

Call sign and location	RCH-RIM Tashkent	RTA Novosibirsk	RKM-RID Irkutsk
Latitude	41° 19'N	55° 04'N	52° 18'N
Longitude.. ..	69° 15'E	82° 58'E	104° 18'E
Frequencies (MHz)	2.5, 5, 10, 15	4.996 9.996 14.996	5.004 10.004 15.004

It will be seen from Fig. 1 that WWV and to a lesser extent WWVH provide information in their announcement periods additional to that required of a simple standard frequency and time signals service. WWV radiates radio propagation forecasts every 5 minutes. These consist of a letter and number code: N=normal, U=unsettled and W=disturbed, while the numbers run from 1 to 9 and indicate a gradation from useless (1) through fair (5) to excellent (9). Time information giving the second, minute, hour and day of the year is emitted in binary coded decimal (b.c.d.) form ten times per hour, i.e. in each 5-minute period except the first and the tenth. The code consists of nine b.c.d. groups, two each for the seconds, minutes and hours and three for the day of year. Code weighting is 1-2-4-8 and a complete time frame occupies 1 second. The code is synchronous with the frequency and time signals, a binary "zero" consisting of 2 cycles of 1,000 Hz and a binary "one" of 6 cycles of 1,000 Hz. The leading edge of the time code pulse coincides with the



FORM OF SECOND AND MINUTE SIGNALS, MORSE AND VOICE ANNOUNCEMENTS (A)

Pulse of 5 cycles of 1,000 Hz tone lengthened to 100 ms at the minute. Call sign and time (U.T.) in morse and voice.

Pulse of 100 cycles of 1,000 Hz tone; no identification of minute. Call sign in morse repeated during two minutes.

Pulse of 5 cycles of 1,000 Hz tone; minute pulse followed by 500 Hz tone for 500 ms. Call sign in morse and voice announcement.

Pulse of 5 cycles of 1,000 Hz tone, repeated 4 times at the minute. Call sign in morse and voice identification.

Pulse of 5 cycles of 1,000 Hz tone, repeated 7 times at the minute. Call sign and time (U.T.) in morse; voice identification at beginning and end of emission.

Pulse of 8 cycles of 1,600 Hz tone, minute pulse preceded by 600 Hz tone for 655 ms. Call sign and time (JST) in morse and voice. Radio propagation warnings in letter code: N (normal), U (unstable) and W (disturbed).

Pulse of 5 cycles of 1,000 Hz tone, 59th pulse omitted. Call sign in morse, identification and time (U.T.-3h) in voice. Tone modulation lasts for 3 minutes in each 5-minute period.

Pulse of 5 cycles of 1,000 Hz tone, lengthened to 100 ms at the minute. Call sign in morse.

Pulse of 5 cycles of 1,000 Hz tone, 100 ms pulse at minute and 500 ms pulse every 5th minute. Last 5 pulses in each quarter hour 100 ms long. From minute 55-60 in every 3rd hour 100 ms pulses lengthened to 500 ms. Call sign in morse. 1,000 Hz tone suppressed from 18.00 to 06.00 U.T.

Pulse of 5 cycles of 1,000 Hz tone, 59th pulse omitted and minute pulse repeated 100 ms later. Call sign and time (U.T.) in morse and voice. Radio propagation forecasts in letter and number code. Time code (second, minute, hour and day of year) ten times per hour. Frequency offset in morse on hour. Geophysical alerts (GEOA) in first half of 19th minute; in second half UT2 time correction.

Pulse of 6 cycles of 1,200 Hz tone, 59th pulse omitted and minute pulse repeated 100 ms later. Frequency offset in morse on the hour. Geophysical alerts (GEOA) in first half of the 49th minute; in second half UT2 time correction. Call sign and time (U.T.) in morse and voice.

Pulse of 5 cycles of 1,000 Hz tone, lengthened to about 500 ms at the minute.

positive-going crossing of the 1,000 Hz modulation so that millisecond time resolution is readily obtained.

FREQUENCY OFFSET AND TIME CO-ORDINATION

Reference has already been made in the footnotes to Table 1 to the different bases of accuracy for the standard frequency emissions. Two distinct aspects are involved here—time co-ordination and the use of offset or non-offset frequencies. As indicated, co-ordination of time signals now embraces nearly all emissions and is clearly a great convenience to the user who may thus make use of co-ordinated stations interchangeably, knowing that they are adjusted to the common time scale U.T.C. and taking care only to apply the propagation delay appropriate to each station. Until recently all co-ordinated h.f. emissions operated with the offset applied uniformly to the carrier frequency and the time signal pulses. This system has the advantage that coherence between carrier and time signals is maintained, the interval between successive time pulses being an exact multiple of the carrier period, e.g. 5,000,000 periods at 5 MHz. The disadvantages are twofold. First, it is undesirable in principle to radiate a "standard frequency" which is, in fact, offset from the internationally agreed standard by several parts in 10^8. Also, the interval between "seconds" pulses is no longer 1 second but differs from the international unit of time interval by the amount of the offset. In consequence the interval between corresponding pulses on successive days, at present, exceeds 86,400 seconds by 2.592 ms. The second objection lies in the application of the system. The offset is designed to harmonize the variable time scale (UT2) based on the Earth's mean rate of rotation on

its axis and the invariant time scale realized by atomic standards. The Earth is subject to unpredictable variations in rate and these are reflected in the yearly adjustments to the value of the offset. In the past these have been as large as 150 parts in 10^{10}, and changes of such magnitude have been disturbing to many users. Where local atomic standards are in use these have to be provided with auxiliary equipment to generate the changing offset if comparisons with received emissions are to continue on the same basis from year to year.

Although several stations have been operating in the l.f. band for some years with non-offset carrier frequencies it was only in 1966 at the C.C.I.R. Plenary Assembly in Oslo that the regulations affecting the h.f. emissions were relaxed to permit the use of non-coherent carriers and time signals. As a result there are now three stations, IBF, MSF and ZUO, as shown in Table 1, where the carrier is no longer offset. The advantages of time co-ordination are so great that the offset for the time signals has been maintained, a time scale converter at the transmitter developing the necessary offset for the time signal generator. In the case of MSF this takes the form of an electro-mechanical phase-shifter which can be readily adjusted in steps of ± 50 parts in 10^{10} to operate at any value of the offset in the range ± 500 parts in 10^{10}. The phase jitter from the device is less than 0.1 μs. Since the 2nd June, 1967, all the MSF carrier frequencies, including MSF 60 kHz, have been derived from a rubidium gas cell standard at Rugby. This also supplies the (offset) drive for GBR 16 kHz. Atomic frequency control is also used for the emissions of WWV and ZUO.

VERY-HIGH FREQUENCIES

The range of v.h.f. emissions is necessarily limited to line-of-sight distances or slightly beyond and it seems appropriate to consider separately the three standard frequency and time signal stations operating in Band 8 (30-300 MHz). The characteristics of the stations are as follows:

Call sign and location	SAZ Enkoping Sweden	SAJ Stockholm Sweden	ZUO Johannesburg S. Africa
Latitude .. .. Longitude	59° 35'N 17° 08'E	59° 20'N 18° 03'W	26° 11'S 28° 04'E
Frequency (MHz) ..	100	150	100

The Swedish stations have zero offset for the carrier frequency and in the case of SAJ, which radiates time signals during its limited period of operation (09·30-11·30 U.T. each Friday) these are coherent with the carrier frequency. SAZ provides a continuous unmodulated carrier. ZUO also radiates continuously a non-offset carrier derived from the atomic standard controlling the lower frequency ZUO emissions, the carrier being modulated with 100 kHz and 1 Hz signals.

LOW AND VERY LOW FREQUENCY EMISSIONS

When the first experimental service from MSF was begun in 1950 it was recognized that the h.f. transmissions would be subject to frequency variations induced in propagation. To provide a more stable reference frequency, therefore, the programme was enlarged to include a short period of transmission on 60 kHz. This ensured ground wave coverage of the British Isles and western Europe: in fact the transmission was also received on the east coast of the United States and following the successful phase measurements there on 60 kHz it was suggested that the MSF oscillator should be used to control the frequency of the Rugby long-wave transmitter, GBR, operating on 16kHz. This was done in 1954 and enabled the MSF standard to be distributed virtually world-wide by means of the favourable propagation at v.l.f. Much of the pioneer work on the stability of v.l.f. propagation was carried out using the GBR transmission and the results led to the extension of precise frequency control to other v.l.f. stations, particularly those operated by the U.S. Navy. The value of v.l.f. emissions for precise frequency (and phase) distribution was recognized by allocating a band of ± 50 Hz centred on 20 kHz to the standard frequency service. At present it is occupied by one of the emissions from station WWVL of the National Bureau of Standards. In addition the International Radio Regulations allow all stations with allocations in the range 14-70 kHz to emit standard frequencies and time signals. The characteristics of stations operating in this band are given in Table 2, the stations being listed in ascending order of frequency from 16 kHz and including the upper part of the l.f. band as far as 200 kHz. The stable propagation which is such a desirable feature of the v.l.f. band makes it a natural choice for the operation of radio navigational systems. There are now many stations established both at l.f. and v.l.f. and emitting highly stable frequencies. By reason of their number and the relative complexity of their schedules these are not included in Table 2 but will be considered separately, later.

Perhaps the most striking feature of the Table is contained in the last row where the figures for the accuracy of frequency control are given. For the majority of the stations listed these are 1 part in 10^{10}, or less. The stable and reproducible nature of propagation in these bands enables a frequency reference to be distributed over distances of the order of 10,000 km with an uncertainty of only one or two parts in 10^{11}, corresponding to a phase stability over 24 hours of 1 or 2 μs. To exploit fully this stability it is desirable that frequency control at the transmitter should be based on an atomic source. Many of the stations in the Table now operate with atomic control. Caesium beam standards are installed at NAA, NLK/NPG, and NSS; rubidium gas cell standards at GBR (and MSF), JJM-6/G2AS, HBG, CYZ40 and Allouis. The emissions of WWVL and WWVB are controlled relative to the master clock at the N.B.S. Boulder Laboratories which in turn is measured daily in terms of the N.B.S. caesium standard. The decline in the use of the frequency offset is most marked for stations in the l.f. band and it is to be hoped that ultimately all stations in this band will operate at nominal frequency in the atomic scale. So far as the broadcast stations are concerned there is, indeed, no requirement for offset since they do not radiate time signals derived from the carrier frequency. As the notes indicate WWVB and DCF77 have discontinued the offset not only for the carrier frequency but also for the time signals which they now emit in agreement with each other, to within 1 ms.

Previously all the v.l.f. transmitters made use of simple on-off keying and this method is still employed to some extent. However, in order to increase communication capabilities the tendency now is to make use of frequency-shift keying. This system is already in use by stations NAA, NBA and NPM, for part of the total operating time. The American practice is to switch between the assigned frequency and a frequency 50 Hz higher, the lower frequency being a space and the upper a mark. The latter frequency e.g. 24·05 kHz for NBA, may not

be phase stable but the lower or assigned frequency as given in Table 2, is at present phase stable. It should be noted, however, that the U.S. Navy has announced its intention of making use in the future of minimum shift keying (m.s.k.) on its communication transmitters. In this mode ambiguities in phase of 180° will exist on both mark and space frequencies and suitably adapted receivers will be required to realise a stable frequency reference. GBR will adopt f.s.k. in the future but here the mark frequency will be 15·95 kHz, 50 Hz below the assigned value. The present accuracy of the 16 kHz carrier will be retained and measures taken to prevent a phase shift when the aerial is returned from on-off to frequency-shift keying, and vice versa. The phase of each carrier will remain coherent throughout the transmission and there will be a smooth transition from one frequency to another lasting about 8 ms, this being the time constant of the GBR aerial. WWVL also makes use of two frequencies, separated by 100 Hz, the carrier being radiated on 20·0 and 19·9 kHz in alternate seconds.

Looking in more detail at the stations in the l.f. band the carrier frequency of the Japanese coast radio station on 40 kHz is now obtained from a rubidium atomic standard the emitted frequency being continuously monitored at the Radio Research Laboratories, Koganei, Tokyo. Telegraph signals are used both for communication as JJM-6 and for standard frequency broadcasts as JG2AS: in the latter case the mark and space signals each last for about 0.5 s. Europe is now particularly well served by standard frequency and time signal tranmissions in this band with stations in continuous operation at frequencies of 50, 60 and 75 kHz and for a limited period each day on 77.5 kHz. In addition, standard frequencies only are provided by the three broadcasting transmitters operating at 164, 191 and 200 kHz. It is foreseen that the carrier frequencies of other broadcasting stations, e.g. Brasov (155 kHz) and Warsaw (227 kHz), will be stabilized in the future. The seconds time signals radiated by HBG and MSF are of the same form, consisting of an interruption of the carrier lasting 100 ms, the time reference being the start of the break. On HBG the minute is marked by two successive carrier breaks and the hour by three: the minute pulse on MSF is lengthened to about 500 ms. Similar carrier interruptions, lasting about 50 ms, are used for the time signals on an atomic scale radiated by DCF77, the minute being identified by suppressing the 59th pulse. In the case of WWVB, time information is transmitted continuously in the form of a b.c.d. code, using a 10 dB shift in carrier level to generate a series of seconds markers. Depending on the coding these markers last for 0.2 s for a binary 'zero', 0.5 s for a binary 'one' and 0.8 s for the 10 s markers. The code embraces minute, hour and day of year information and also the difference in milliseconds between the time as emitted and the current estimate of UT2.

NAVIGATIONAL STATIONS

Loran-C.—The development of a long-range radio navigation system is authorized in the band 90-110 kHz. This relatively wide band is clearly suitable for a pulsed system and pulses of length about 30 μs are used in the Loran-C hyperbolic navigational aid, all stations of which operate at a carrier frequency of 100 kHz. Chains of between 3 and 5 stations are operational in the general areas of the East Coast of the United States, North Atlantic, Norwegian Sea, Mediterranean, N.W. Pacific, Hawaii and the Aleutians. Each station radiates a group of 8 pulses (9 for the master station in each chain) spaced 1 ms apart, the pulses being sufficiently short to allow separation of the ground wave from the first sky wave at distances in excess of 2,000 km. Chains are distinguished by differing intervals between pulse groups. The Loran-C stations are only useful for timing purposes when this interval is a sub-multiple of T seconds, T being a small integer. This condition is not satisfied for most of the chains but for the U.S. East Coast chain the group period is 100 ms and in addition this chain is precisely controlled in time relative to the time standard of the U.S. Naval Observatory. The master station is located at Cape Fear, N. Carolina (34° 04′N, 77° 55′W) and the first pulse of one of the groups is emitted at 0 s U.T.C. To resolve the time ambiguity resulting from the 100 ms group period a 1 s pulse is added to the Cape Fear emissions and emitted 2 ms ahead of the 0 s U.T.C. pulse. The other stations of the chain do not transmit this 1 s marker but their emission delays relative to the master are published by the U.S. Naval Observatory.

Omega.—The previously unused part of the v.l.f. band in the region 10-14 kHz is now being exploited by the Omego navigational system. In its final form eight stations, emitting several frequencies on a time-sharing basis, will provide a world-wide hyperbolic phase-comparison system which should enable position fixing with an r.m.s. error of about 1 km during the day and about 2 km at night. There are now four stations operating as part of the research and development programme on frequencies between 10.2 and 13.6 kHz. Their main characteristics are as follows:

Location	Aldra Norway	Forestport New York	Haiku Hawaii	Trinidad
Latitude	66° 25′N	43° 27′N	21° 24′N	10° 42′N
Longitude ..	13° 09′E	75° 05′W	157° 50′W	61° 38′W
Frequencies (kHz)	10.2, 13.6	10.2, 11.33, 12.4, 12.5, 13.6	10.2, 13.6	10.2, 11.33, 12.0, 13.6

When the Omega system receives full approval it is likely that the above stations, with the exception of Forestport, will become operational stations and will be joined by others located in the United States, South America, the Indian Ocean, Australasia and the Philippines-Okinawa area. Each of the experimental stations is equipped with three caesium atomic beam standards, one of which controls the emission. The latter consists of a series of frequencies transmitted in successive 1-second intervals, the sequence repeating after 10 seconds. The first segment starts at 0 s U.T.C.: all times are synchronized with the time standard of the U.S. Naval Observatory and all frequencies are offset. The frequencies of 10.2, 11.33 and 13.6 kHz are common to all stations although emitted at different segments of the 10-second sequence for each station. To receive these frequencies, therefore, a commutator is necessary at the receiver, synchronized with the emission pattern and phased to isolate the appropriate 1-second segment of the desired station. In addition each station will radiate a unique frequency which can be received without using a commutator although some form of gating may still be desirable to improve the signal-to-noise ratio. At present Trinidad is transmitting a unique frequency of 12.0 kHz while Forestport is operating experimentally on 12.4 and 12.5 kHz.

Thanks are due to the many organizations which have made available details of their standard frequency emissions. This survey has been prepared at the National Physical Laboratory as part of the information programme for the standard frequency services.

NEWS FROM INDUSTRY

"The largest microelectronics manufacturing plant in Europe" is the claim of the Marconi Company for this project at Witham, Essex, soon to be ready for the production of integrated circuits. The company has invested £3M in the project.

G.E.C. (Telecommunications) Ltd. are to supply over £8M worth of equipment and services towards the next £13M phase of the Nigerian national telecommunications plan. The company will provide a 2,500-mile long microwave and v.h.f. radio network that will be integrated with the country's existing telecommunications system. G.E.C. will be responsible for all aspects of the project from surveying the route to bringing the equipment into operation and training engineers.

The **Data Equipment Division of Plessey Automation** have announced a new range of incremental magnetic tape recorders that have been developed in conjunction with the National Research Development Corporation. The recorders feature a new stepping mechanism that replaces the usual stepping motor. Modular construction allows several different versions to be built up from the basic unit and facilitates servicing. Prices start at £1,000.

The Electro-Mechanical Division of **Standard Telephones and Cables Ltd.** have formed a sub-system design department enabling non-electronic companies to have electronic logic control systems designed, built and fitted to their machinery or products without the need to employ a permanent electronics staff. The department is known as EMD (Logic Control Sub-systems), and is housed at West Road, Harlow, Essex.

Twenty-four manufacturers of fractional horse-power motors have combined to form the **British Fractional H.P. Manufacturers' Association** with headquarters at 8, Leicester Street, London, W.C.2. Technical co-operation between members is being encouraged, although all firms will remain independent and in competition with each other.

The Soviet Ministry of Communications have placed a £200,000 order with **Marconi Ltd.** for self-tuning receiving equipment which will consist of a number of solid state double diversity independent sideband receivers together with associated equipment.

The West German Defence Ministry have ordered a year's supply of kalium batteries at a cost of £44,000 from **Vidor Ltd.**, Royston. The batteries will be used for the air-sea rescue beacons carried by the West German Air Force.

R.C.A. Colour Tubes Ltd. started production at their new factory at Skelmersdale, Lancashire, on July 17th. It is planned that by the end of 1967 a total of 10,000 colour television tubes will have been distributed to the trade and it is expected to more than double this figure in 1968. R.C.A. Colour Tubes Ltd. was set up last year by the Radio Corporation of America and Radio Rentals (see "News from Industry" October, 1966).

Marconi International Marine Co. Ltd., intend to withdraw from the business of installing land-based sound systems although existing installations will continue to be serviced in accordance with contractual obligations. This move will enable the company to concentrate its resources on its shipping interests and this will involve a gradual run-down and ultimate closure of the Electra Sound Systems division.

The Automation Group of the **Plessey Company**, Poole, Dorset, is to receive the support of the National Research Development Corporation in the development of a digital sequence control machine employing integrated circuits. The machine will be employed in low-cost process control applications that do not justify using a general purpose computer. The development programme is scheduled to run for 2½ years by which time the first production models should be available.

Standard Telephones and Cables Ltd. have started to install the first of **London's p.c.m. telephone equipment.** Work is progressing on two routes, the first of these serves Redhill and Caterham and the second Sunbury, Ashford, Staines, Walton, Weybridge and Esher. Existing telephone circuit capacity will be increased by 48 or 96 circuits depending on requirements. In this first phase of the scheme S.T.C. are providing 40 p.c.m. systems necessitating the installation of some 960 repeaters in existing manholes and footway boxes.

G. & E. Bradley Ltd., of Neasden Lane, London, have been appointed exclusive U.K. agents for a range of electronic instruments manufactured by Monsanto Electronics Technical Center, of West Caldwell, New Jersey, U.S.A. The range includes a frequency synthesizer, counter/timers and digital voltmeters which all utilize integrated circuits.

Siliconix Agents.—The Micro Electronics Division of Ultra Electronics (Components) Ltd., Park Royal Road, London, N.W.10, have been appointed sole distributors in the U.K. of semiconductor devices manufactured by Siliconix Inc., California.

WEL Components Ltd., Reading, Berks., have been appointed sole U.K. agents for the Gremar Manufacturing Company, Wakefield, Massachusetts, who manufacture a range of coaxial plugs, sockets and adaptors.

I.C.T.'s Computing Services Division is to be re-formed as a wholly owned subsidiary of the I.C.T. group of companies under the title International Computing Services Ltd.

Arrow Electric Switches Ltd., of Southall, Middlesex, have opened a new office and stores at 13 Murray Place, Stirling, to cope with the increasing demand of the expanding Scottish electrical and electronics industries.

Technical Representation Ltd. have been appointed sole U.K. agents for the Exellon Industries of California, who manufacture a range of drilling machines for printed circuits.

Joseph Lucas (Electrical) Ltd., have announced price cuts of up to 30% on their range of semiconductors.

The Cambridge Instrument Company Ltd. reports for 1966 a profit before tax of £495,000 compared with £499,000 last year.

SEPTEMBER CONFERENCES & EXHIBITIONS

Further details can be obtained from the addresses in parentheses

LONDON

Sept. 11-15 — Olympia
Industrial Photographic and Television Exhibition
(Industrial and Trade Fairs, Commonwealth House, New Oxford St., W.C.1)

Sept. 11-15 — Olympia
Engineering Materials and Design Show and Conference
(Industrial and Trade Fairs, Commonwealth House, New Oxford St., W.C.1)

Sept. 13-14 — I.E.E. Savoy Pl.
High Voltage Insulation in Vacuum
(I.P.P.S., 47 Belgrave Sq., S.W.1)

Sept. 20-22 — Royal Lancaster Hotel
International Broadcasting Convention
(I.B.C. Secretariat, Royal Television Soc., 166 Shaftesbury Ave., W.C.2)

Sept. 20-22 — University College
Stress Analysis in Bio-engineering
(I.P.P.S., 47 Belgrave Sq., S.W.1)

Sept. 26-28 — Savoy Pl.
Magnetic Materials and Their Applications
(I.E.E., Savoy Place, W.C.2)

Sept. 27-30 — R.H.S. New Hall
R.S.G.B. Radio Engineering & Communications Exhibition
(P. A. Thorogood, 35 Gibbs Green, Edgware, Middx.)

BIRMINGHAM

Sept. 19-21 — The University
Individual Responsibility for Quality & Reliability
(Inst. Engineering Inspection, 616 Grand Bldgs., Trafalgar Sq., London, W.C.2)

CULHAM

Sept. 11-13 — U.K.A.E. Laboratory
Waves in Plasma
(I.P.P.S., 47 Belgrave Sq., London, S.W.1)

LEATHERHEAD

Sept. 21-22 — Cent. Elec. Research Labs.
Electrodeless Breakdown of Gases
(I.P.P.S., 47 Belgrave Sq., London, S.W.1)

MANCHESTER

Sept. 5-7 — The University
Physics of Quasars
(I.P.P.S., 47 Belgrave Sq., London, S.W.1)

Sept. 5-8 — The University
Solid State Devices
(I.P.P.S., 47 Belgrave Sq., London, S.W.1)

Sept. 26-30 — Belle Vue
Electronics, Instruments, Controls & Components Show
(Institution of Electronics, Pennine House, Shaw Rd., Rochdale, Lancs.)

ST. ANDREWS

Sept. 19-21 — The University
Electron Optics, Instrumentation and Quantitative Electron Microscopy
(I.P.P.S., 47 Belgrave Sq., London, S.W.1)

SUTTON COLDFIELD

Sept. 19-20 — Town Hall
Components, Instruments & Control Gear
(Hawnt & Co., 112/114 Pritchard St., Birmingham 6)

SWANSEA

Sept. 11-15 — University Col.
Radio Receiver Systems
(Dr. R. C. V. Macario, Electrical Engineering Dept., University College, Swansea, Glam.)

OVERSEAS

Sept. 1-10 — Paris
International Radio & Television Show
(Federation Nationale des Industries Electroniques, 16 rue de Presles, 75 Paris 15)

Sept. 4-6 — Balatonszeplak
Industrial Electronic Measuring & Control Symposium
(Federation of Hungarian Scientific Societies, c/o Hungarian Embassy, 35 Eaton Pl., London, S.W.1)

Sept. 4-8 — Vienna
I.F.A.C. Syposium on Automatic Control in Space
(Austrian Productivity Centre, Committee on Automation, POB 131, A-1014 Vienna)

Sept. 4-10 — Mexico City
S.I.M.A. Exhibition of Measuring Instruments
(Scientific Instrument Mftrs' Assoc., 20 Peel St., London, W.8)

Sept. 4-11 — Leipzig
Autumn Fair
(Lex Hornsby & Partners Ltd., 125/130 Strand, London, W.C.2)

Sept. 6-8 — **Chicago**
Computer Conference
(I.E.E.E. 345 E.47th St., New York, N.Y. 10017)

Sept. 9-17 — Milan
Italian Radio & Television Show
(Mostra Nazionale della Radio et Televisione, Via Luciana Manara 1, Milan)

Sept. 10-19 — Brno
International Trade Fair
(Fairs & Exhibitions Ltd., 14 New Burlington St., London, W.1)

Sept. 11-14 — Haifa
I.F.A.C. Automatic Control Symposium
(Israel Committee for Automatic Control, Technicon City, Haifa)

Sept. 11-15 — Athens
Information Theory Symposium
(I.E.E.E. 345 E.47th St., New York, N.Y. 10017)

Sept. 16-22 — **Boston**
Eurofair U.S.A.
(Eurofair U.S.A. 94 Gerrit va der Veenstraat, Amsterdam-Z, Netherlands)

Sept. 17-22 — Chicago
S.M.P.T.E. Exhibition & Conference
(Society of Motion Picture & Television Engineers, 9 E.41st St., New York, N.Y. 10017)

Sept. 21-22 — Detroit
Electronics in Vehicle Safety and Traffic Control
(I.E.E.E., 345 E.47th St., New York, N.Y. 10017)

Sept. 21-23 — Washington
Broadcast Symposium
(I.E.E.E., 345 E.47th St., New York, N.Y. 10017)

Sept. 21-23 — Kyoto
Anglo-Japanese Electronics Symposium
(B.N.E.C. Asia, 6-14 Dean Farrar St., London, S.W.1)

Sept. 21-Oct. 1 — Amsterdam
Firato Electronics Show
(R.A.I. Gebouw N.V., 8 Europaplein, Amsterdam)

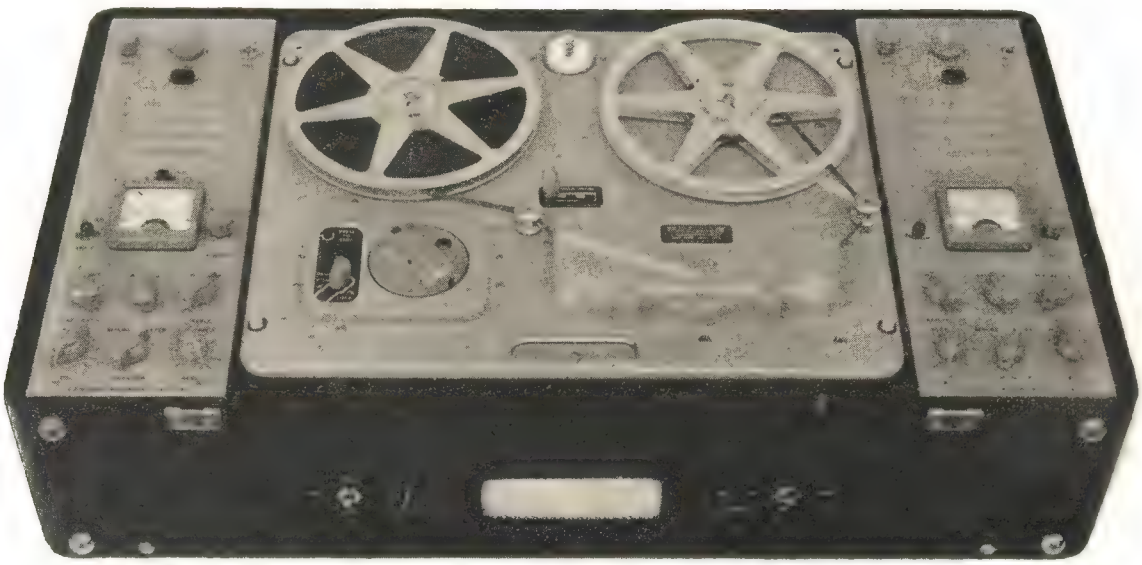
Sept. 25-27 — Toronto
International Electronics Conference
(I.E.E.E. 1819 Yonge St., Toronto 7)

Sept. 28-Oct. 4 — Osaka
Electronics Show
(British Embassy, Tokyo)

Sept. 29-Oct. 7 — Brussels
British Week
(BNEC Export Council for Europe, 27 Northumberland Ave., London, W.C.2)

Vortexion quality equipment

TYPE C.B.L. TAPE RECORDER



Here is a versatile stereophonic recorder which has no equal in its price group.

IT CAN record monaurally or stereophonically with its own mixed inputs from Gram, Radio or other sources and from high grade low impedance balanced line microphones. With good microphones, etc., the result is a suitable master for disc manufacturers. " Before and After " monitoring is provided together with adjustable metered bias for perfection.

IT CAN also make a recording on one track and then transfer it to the other track while measuring and listening to it and adding one or two more signals also metered. A special PPM type meter is now used.

IT CAN repeat the process and transfer this combined signal to the first track with one or two more signals. Composers use it for this purpose. One track may have music or commentary and the other cueing signals or commentary and either may be altered without the other.

IT CAN playback stereophonically or monaurally with its own amplifiers of $3\frac{1}{2}$ watts each.

Speeds $1\frac{7}{8}/3\frac{3}{4}/7\frac{1}{2}$ i.p.s. Price **£172 0s. 0d.**
Speeds $3\frac{3}{4}/7\frac{1}{2}/15$ i.p.s. Price **£180 0s. 0d.**

The Vortexion W.V.B. is a high quality monaural machine with " Before and After " monitoring. The recording inputs are a high sensitivity socket for moving coil or ribbon microphone and a high impedance socket for radio, etc., either of which can be selected by a switch. Superimposing and echo work can be done and the playback has reserve gain for abnormal requirements. This model cannot be converted for stereo playback, but it is a thoroughly reliable machine for the engineer specialising on monaural work.

Speeds $1\frac{7}{8}/3\frac{3}{4}/7\frac{1}{2}$ i.p.s. Price **£115 10s. 0d.**
Speeds $3\frac{3}{4}/7\frac{1}{2}/15$ i.p.s. Price **£128 0s. 0d.**

The Vortexion W.V.A. is a monaural machine which has a performance equal in sound quality to the other models. It possesses all the features of the W.V.B. except for " Before and After " monitoring, Dubbing and Echoes. The recording being made can be heard on the internal loudspeaker as in the W.V.B. and C.B.L. The controls are uncomplicated.

Speeds $1\frac{7}{8}/3\frac{3}{4}/7\frac{1}{2}$ i.p.s. Price **£96 7s. 0d.**
Speeds $3\frac{3}{4}/7\frac{1}{2}/15$ i.p.s. Price **£107 3s. 0d.**

All tape recorders have adjustable bias controls, low impedance mic. inputs for unlimited lengths of cable, highly accurate position indicators and meters to measure recording level and bias.

VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, S.W.19

Telephone: 01-542-2814 and 01-542-6242/3/4 **Telegrams: "Vortexion London S.W.19"**

WW—101 FOR FURTHER DETAILS

Radio towers

Fixed, portable and telescopic masts

Co-axial and open-wire feeders

Aerials (LF to HF): rhombics, log periodics, dipoles, quadrants, 'T'-aerials, wide-band aerials

Aerials (VHF to microwave): yagis, ground plane, helices, dipoles, dishes

Filters

Aerial switches

Lead-in panels

Earth systems

Air-cooled transmitter loads up to 20kW

Termination networks

Propagation surveys

Site layouts and installation

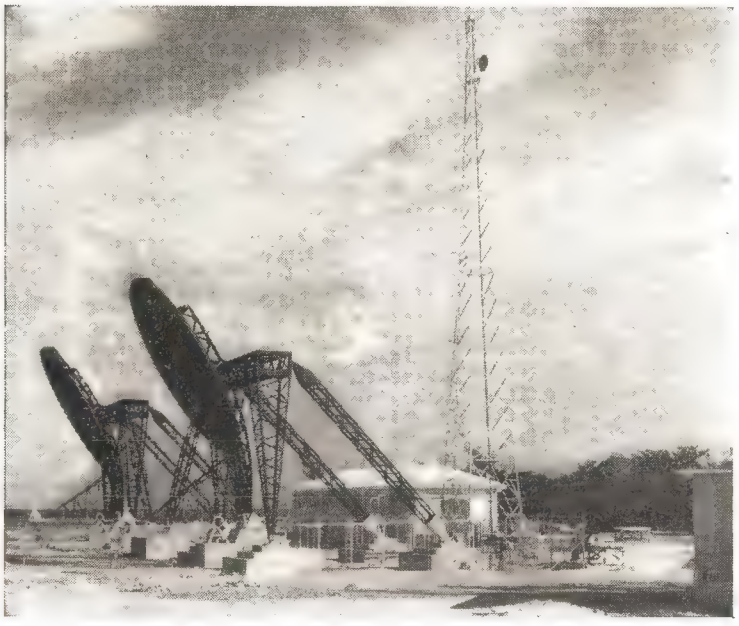
Coubro & Scrutton

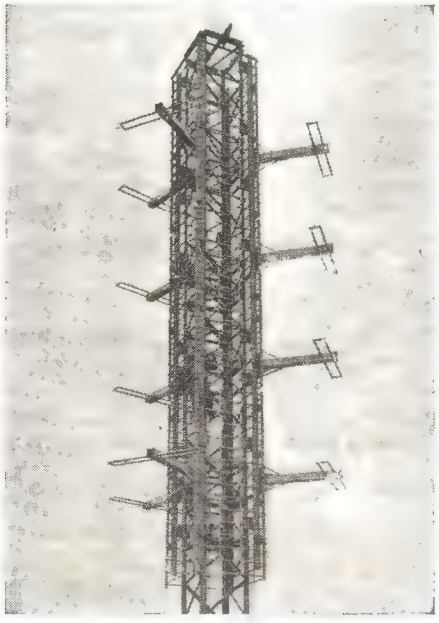
a complete aerial service

(LF to Microwaves)

INSTALLATIONS IN OVER 200 COUNTRIES

BROADCASTING
POINT TO POINT
GROUND TO AIR
NAVIGATIONAL AIDS
MARINE AERIALS





The Coubro & Scrutton Companies

LF, MF and HF: Coubro & Scrutton Ltd.
VHF and UHF: Associated Aerials Ltd.
Microwaves: Precision Metal Spinnings Ltd.
Business Radio: R. T. Masts Ltd.
Telescopic Masts: A. N. Clark (Engineers) Ltd.

COUBRO & SCRUTTON LTD.
Group Sales Office, 430 Barking Road,
London E13 Tel: 01-476-4477
Telex 25850 Cables: Coubro London E13

WW—102 FOR FURTHER DETAILS

CS10

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Noise Figure Measurement

IN his article on noise figure measurement in the August issue Mr. Matthews does the usual trick of doubling the output power reading, the first reading being noise power only and the second noise plus signal generator. The signal generator setting during the initial phase is described as " set so that the amplifier is operating at the lower limit of normal working conditions ". Since this is the first of two settings from which the noise figure is derived it seems to require more accurate definition.

Later he says " the ratio of the new signal to the old is S_i/N_i ". Surely if the " old " is N_i, the " new " is S_i+N_i? The ratio is then $\frac{S_i+N_i}{N_i}$.

But since the noise figure is then taken as the difference of readings, and since we are speaking of 8 dB, or about 6:1, the first reading is one sixth of the second, and obviously cannot be negligible. A true version of the ratio is therefore: $\frac{S_2+N_i}{S_1+N_i}$ where S_2 and S_1 are two attenuated signal levels. The *apparent* noise figure quoted by Mr. Matthews is then S_2/S_1 (not S_2/N_i). But ignore the signal-to-noise equation for a moment and let us see what we have got. If the noise figure is F, and the power gain G, then the output at phase one is $G(FN_i+S_1)$. Later, when we have increased the signal, the output is $G(FN_i+S_2)$. The second is made to double the first, so: $G(FN_1+S_2) = 2G(FN_1+S_1)$, whence:—

$F=\frac{S_2-2S_1}{N_i}$ which goes towards Mr. Matthews' expression only if S_1 goes to zero. For F to equal $F_{apparent}$, therefore, $\frac{S_2}{S_1}=\frac{S_2-2S_1}{N_i}$

giving $N_i=S_1(1-2/F_{app})$.

If F_{app} is 6.3:1, this gives $S_1=1.46N_i$, a very specific value indeed. An examination of Mr. Matthews' table shows that in fact the Magnetic AB measurements differ from the others by about unity when taken as numerical ratios. This would suggest:

$$\frac{S_2}{S_1}-1=\frac{S_2-2S_1}{N_i}.$$

This gives: $F_{app}-1=\frac{S_1}{N_i}(F_{app}-2)$ or $S_1=\frac{N_i(F_{app}-1)}{F_{app}-2}$

or about $1.2N_i$.

It becomes clear that for the measurements to have any meaning, the first signal level must have some definite relation to the amplifier noise level. If it does not, we know nothing about N at all beyond the fact that if one can just " see " the signal on the meter it is within a few dB of N. The true expression for F includes S_2, S_1, and N_i. The attenuator readings only give S_2 and S_1. They tell us nothing accurate about N_i. (S_2/S_1 does not equal S_2/N_1. Even if it did it could not then be ignored in phase one, for S_1 would equal N_i.)

F. V. BALE & M. J. S. QUIGLEY

Slough, Bucks.

The author replies:

I WOULD like to thank Messrs. Bale and Quigley for their interest.

The point that they seem to have missed is that we *cannot* measure noise and signal separately and must therefore deal in terms of changes rather than in absolute values. This can be confusing when we consider the input side. The new signal S_1, is S_x+N_i, *where* N_i is the initial signal and S_x is the amount by which it was increased. N_i corresponds to the cold termination noise of the calibrated source used in conventional noise figure measurement, S_i is this noise plus the noise generated in the source. The dB relationship between hot and cold noise is of course the excess noise of the source. In a gas discharge source we can control this excess noise by using an attenuator, in a temperature limited diode by varying the filament voltage. In neither do we make an absolute measurement of either hot or cold noise. All that we need is the dB change in noise input to the device under test.

A signal generator used in the manner described simulates a noise source except that it provides a single frequency instead of the wide-band signal provided by a conventional source. Since the output is still the amplified input plus internally generated noise this does not invalidate the usefulness of a signal generator for making quick, approximate noise figure checks.

C. N. G. MATTHEWS

Feltham, Middx.

Energy Storage in Smoothing Systems

THE energy storage concept discussed by Mr. Arguimbau in the May 1967 issue offers advantages which make further exploration profitable. It may first be noted that if a choke is roughly one-half iron, one-half copper, a figure of 0.1 watt-sec/lb, corresponding to about 0.025 watt-sec/in^3, is about equivalent to a working point of 0.1 HA^2/in^3 on the Hanna curves. Although for C-cores the published curves extend up to 0.2 HA^2/in^3 we can rarely obtain a satisfactory design at this level.

In most design problems the amount of ripple is fixed. If we rearrange the equation for ripple in the form

$$W_L W_C=\frac{P^2}{135\pi^2 f^2}\cdot\frac{E}{E_{ripple}}=K,$$

and we take the storage density of a capacitor as r times that of a choke, we can easily find that the minimum volume smoothing system will be obtained if

$$W_L=\sqrt{(K/r)} \text{ and } W_C=\sqrt{(Kr)}$$

A typical value of r is about 10. This result can also be obtained to secure a minimum cost solution, if we now take r as the ratio of the watt-sec/shilling. Here a random

catalogue choice gives 120 shillings per watt-sec for a choke and 6 shillings per watt-sec for a capacitor, so that $r = 20$.

When an optimum choke is sought for the 15 V, 1 W, 60μV ripple example discussed by Arguimbau we find that the solution is a choke of such high resistance that the open-circuit voltage would be intolerable in many transistor applications. To estimate the useful region we can proceed in the following way. For any particular mechanical size of choke we have $R_L = K_1 L$, and thus the voltage drop in the choke can be written

$$IR_L = 2K_1 W_L / I.$$

If we now fix a limiting value of IR_L/V for the safe fractional rise of voltage under open-circuit conditions (or, more strictly, light load) we have

$$\frac{IR_L}{V} = \frac{2K_1 W_L}{P}.$$

In the minimum volume case the ratio W_L/P depends only on the ripple ratio and making further bold, or rash, assumptions we reach, as a design limit guide, a ripple ratio of 1/1000. This is rarely likely to be a troublesome limit: very quiet power supplies are nowadays usually required to be well-regulated, and the regulator will deal easily with this level of ripple.

We now note that

$$\frac{W_L W_C}{P^2} = \frac{r W_L^2}{P^2} = \frac{E}{E_{ripple}} \cdot \frac{1}{135\pi^2 f^2}.$$

For $E/E_{ripple} = 1000$, $f = 50$ Hz and $r = 10$, this leads to the simple result,

$$W_L = P/180 \text{ and } W_C = P/18.$$

Reducing the smoothing to give $E/E_{ripple} = 100$, we have

$$W_L = P/570 \text{ and } W_C = P/57$$

We can now go on to estimate the actual volume of the smoothing circuit, and we find that for the ripple ratio of 1000 it is about $P/2$, while for the ripple ratio of 100 it is about $P/6$. Chokes and capacitors being the shapes they are, it is unprofitable to calculate with any precision.

As an example let us take a 12 V 10 A supply with 120 mV ripple. The volume will be about 20 in^3. A 25,000 μF capacitor (15 V wkg) is a cylinder of volume 12 in^3. A choke with a core of 5 in^3 volume will have a weight of 1.35 lb, which corresponds to a double-loop C-core ref. HWR 40/16/13. At 120 AT/in we find we need 84 turns, or 68 T/in^2 of winding area. A winding of 11 s.w.g., rated at 10.57 A, gives 68.5 T/in^2. This is rather near the knuckle, to put it mildly, and rather than move to a higher storage density we can use a single loop of HWR/50/14/13.

From the energy storage/power expressions we obtain values of L and C as 4 mH and 28,000 μF. Our core weighs 1.56 lb, so that we can get about 6 mH, while our capacitor has a 15 V rating, which accounts for the short-fall.

This example was a quite genuine random choice and there have been no painful reappraisals on separate scraps of paper. The 96 turns on the choke will mean a winding density of 57 T/in^2, a reasonable margin. The resistance of this winding, which gives a drop of only 0.5 V, indicates that our first guess would have done had we accepted a wire rating of 1500 A/in^2.

It would appear that we can design smoothing circuits using the energy-storage concept so that we demand, for a smoothing ratio of 100, a capacitor having V wkg volts and a volume of $P/12$ in^3, and a choke for I amps of weight $P/50$ lb. on a core weighing $P/100$ lb.

I must confess to some surprise at the apparent strength of this method as a short-cut to an approximate design.

THOMAS RODDAM

London, W.8.

Radio Interference from Motor Speed Regulators

THE article by K. C. Johnson in the July issue on thyristor circuits for controlling the speed of appliances containing small motors will undoubtedly arouse considerable interest. The method is simple, effective and capable of much wider application. There are, however, certain aspects which do not appear to have received much attention and one of these is the problem of radio interference. Several circuits have been examined by the E.R.A. and all have shown r.f. terminal voltage levels considerably in excess of the limits specified for domestic appliances in B.S.800. Typical values at 200 kHz for circuits without suppression are in the range 100-120 dB/1μV. These values are so far in excess of the specified limits that widespread interference may be caused and failing effective voluntary suppression it would seem likely that some form of statutory control might have to be imposed. If the speed control circuit is installed in an electric drill or similar appliance, suppression components can also be installed and reduction of the interference to below the specified limit can be achieved without recourse to a complex filter. If, however, the control circuit is a separate unit which may be located some distance from the appliance, then suppression will generally be necessary at both input and output. Since the levels of interference are high in the long and medium wave bands capacitive suppression alone is inadequate and it is necessary to install inductors. Inevitably transient surges are generated which may cause damage to the thyristor. The use of thyristors rated at 400 volts is recommended to withstand peak mains voltage but this rating may be inadequate to withstand additional transient voltages. Currently specified radio interference measuring techniques involve the use of a mains isolating network containing inductances of several millihenries and here again the transient voltages may cause damage. These aspects of the problem including the development of a satisfactory measuring technique are currently being examined at the E.R.A.

G. A. JACKSON

Electrical Research Assoc.,
Leatherhead, Surrey.

Transistor Curve Tracing

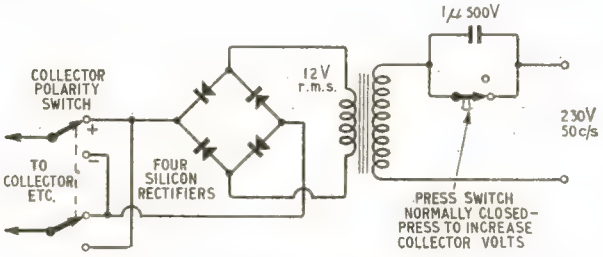
THE article by G. B. Clayton on transistor curve tracing in the June issue interests me, for the circuit shown is similar to one that I have been using for some time. Two simple improvements may be of interest.

Mr. Clayton's oscilloscope photographs show a bright spot at the zero point of the trace. This is caused by the use of a half-wave rectified collector supply—the spot rests for half a mains cycle at the zero point and makes one voltage excursion for the remaining half cycle. The trace brilliance must be adjusted for a satisfactory curve paint and this results in an excessively bright zero-point bright spot that may damage the screen. The use of a full-wave rectified collector supply eliminates this bright spot for the curves are now painted twice per mains cycle. A bridge rectifier is satisfactory in this application.

Mr. Clayton limits his collector voltage to about 17 V (peak). This is usually too low to exhibit the breakdown characteristics of transistors. The curve tracer is an ideal instrument for investigating breakdown ratings because the average power dissipation in the sample is kept within acceptable limits while doing so. To restrict the tracer to a limit of only 17 V at most is, in my opinion,

to get only half the value from the unit. A simple expedient to almost double the collector voltage is to put a capacitor in series with the transformer primary. This increases the primary current and hence the secondary voltage. I have found that a 1 μF 500 V paper capacitor to be satisfactory with the transformer I have in use (12 V domestic bell transformer with 230 V primary). A normally closed press-to-open microswitch in parallel with the capacitor ensures normal operation—pressing the microswitch brings the capacitor into circuit and increases the collector voltage to display the breakdown characteristic. If the transformer has loose laminations, the additional current produces a buzz to audibly warn that the unit is operating on its high voltage range. This method may seem to be extremely crude but it is most effective. No damage to the transformer or any transistor has occurred through the use of this arrangement. Consideration of the mains input power factor (etc.) shows that no ratings are exceeded. The use of a press switch ensures that operation in the high voltage range must be intentional.

These two improvements are shown on the diagram below.



I congratulate Mr. Clayton on producing an interesting article and concur with his remarks about the value of semiconductor curve tracers. His circuit is confined to common-emitter characteristics. By suitably reconnecting the sample, the characteristics in common-base and common-collecor can be displayed. I have used my tracer to display characteristics of thyristors, diodes, Zeners, uni-junction transistors, p-n-p and n-p-n transistors, and p-channel and n-channel f.e.ts. It is a most useful device educationally.

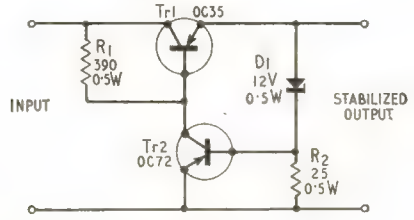
J. F. C. JOHNSON

Central Inst. of Technology,
Petone, New Zealand.

High-efficiency Voltage Regulation

AFTER reading the letters of Mr. Pasch and Mr. Williams (May and June respectively) concerning high efficiency voltage regulations, I feel that a circuit which I developed some time ago may be of interest. The circuit was originally designed for supplying an output of 12 volts at 500mA.

The Zener current is held reasonably constant since it is fed from the stabilized output side of the supply



(provided the quiescent Zener current is substantially greater than the leakage current of Tr1 and the base current of Tr2).

The circuit also offers the additional advantage of clamping very fast pulses which could not normally be followed by the regulator, since the e-b junction of Tr2 appears effectively in series with D.

MALCOLM BARETTE

Portland,
Dorset.

Using Integrated Circuits

I WAS pleased with the interest shown by readers in my recent article on an i.c. stereo mixer, as evidenced by the letters in the August issue. On the rather minor economic point, I would query whether Mr. Short's "cheaper" discrete component circuit would "do the same job." His input transistors are in the common-emitter mode, less suitable for use from high-impedance sources. In turn, the CD 2200 follows the common-collector inputs with a 3-stage amplifier, in which heavy negative feedback to maintain the signal/noise ratio is applied. I would maintain that, to achieve comparable performance, at least twelve transistors, plus several resistors would be required to replace the i.c., even with the most economical design. The i.c. therefore at least breaks even, and from the viewpoint of sophistication and convenience, is superior. "The millenium has arrived."

A. J. MCEVOY

Larne, Co. Antrim.

Honorifics

THE Editorial in the June issue and letters in July regarding professional engineers and technicians is all very interesting but omits one vital point.

A scan through the situations vacant advertisements is sufficient proof that employers consider the holder of a Higher National Certificate to be a professional engineer, not a technician. Many advertisements ask for qualifications of B.Sc., H.N.C., etc., presumably because these employers consider these two qualifications roughly equivalent.

Consequently, if the holder of an H.N.C. joins a body with the word technician in its title, he is lowering his status.

There is another body known as the Society of Engineers which accepts the H.N.C. as a requirement for membership and I suggest that this is the professional society that H.N.C. holders should join.

JEFFREY RENDALL

Port Stanley,
Falkland Islands.

IT was with interest that I read your June editorial and the letters in the July issue dealing with the qualifications required for membership of professional bodies. It is, however, worth noting that the most prized professional honorific, i.e., F.R.S., is not obtained by written examination but by selection, with reference to the importance of the work done.

JOHN D. BENSON

Bedford.

The last line of Mr. Oakenfull's letter in the July issue should have read:—"I have ignored the effect of the increase in I'_{co}."

LITERATURE RECEIVED

Revised and expanded editions of **Logic Handbook** and **Small Computer Handbook** are available not only to professional users, but also for schools and industrial training programmes. The former publication of over 400 pages includes an educational primer discussing digital logic, and analogue-to-digital conversion, and a section on the logic laboratory. Other sections contain detailed specifications of Digital's Flip Chip modules. The latter publication includes a primer on the use of a digital computer and sections on products by Digital Equipment Corporation (U.K.) Ltd., 3 Arkwright Road, Reading, Berks.
WW 333 for further details

A comprehensive 224-page Welwyn **component catalogue** describes all the company's film resistors and power and special resistor products including potentiometers. A special section covering integrated circuits includes hybrid (passive and active circuits), attenuators and precision resistor networks. There is a general information section giving cross references to Welwyn products against National/International, Post Office and Defence specifications, as well as details of resistor preferred values and resistor markings. Welwyn Electric Ltd., Bedlington, Northumberland.
WW 334 for further details

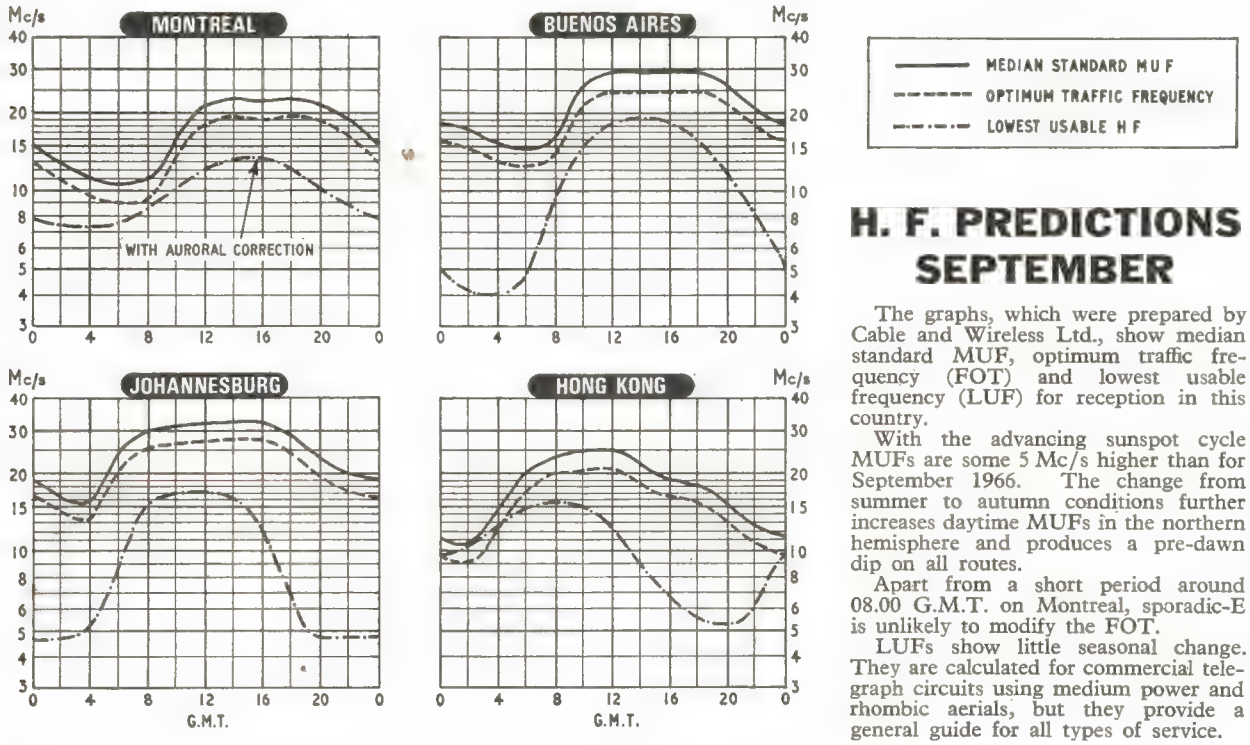
Both Electronic Services-STC and Electroniques are to extend distributing activities into the field of **technical books.** Five publishers of technical and reference books (Iliffe Books, Foulsham Sams, R.S.G.B., Editors & Engineers and David Rayner Associates) will have books selected from their current title lists and these will be marketed by the above-named services. About 170 titles are involved and a 40-page booklet giving details of them—publication MG222S2—can be obtained from Electronic Services-STC, Edinburgh Way, Harlow, Essex.
WW 335 for further details

A leaflet on the probability slide rule by the Rolatape Corporation, U.S.A., is available from the U.K. importers Entwistle Thorpe & Co. Ltd., 86-88 Pentonville Road, London, N.1. Of value and interest to those concerned with the **measurement and analysis of random data,** this rule permits direct reading of probability values for Gaussian, Rayleigh and Maxwell distributions on one side. The other side is used to compute the probability of no successes or at least one success in a given number of independent trials.
WW 336 for further details

High- and low-melting point solders for special applications, and where melting points outside the normal tin/lead range are necessary, are listed in the leaflet Technical Memorandum No. 3, Soft Solders for Special Service received from Enthoven Solders Ltd., Dominion Buildings, South Place, London, E.C.2.
WW 337 for further details

Professional Cathode Ray Tubes contains 13 pages of technical data on c.r.ts for applications ranging from automation and avionics, through medical electronics to ultrasonics. Two pages are allocated to a tabular description of tube phosphors and nomenclature. The M-O Valve Co. Ltd., Brook Green Works, Hammersmith, London, W.6.
WW 338 for further details

Fourth edition of the **Handlist of Basic Reference Material** for Librarians an Information Officers in Electrical and Electronic Engineering has been received from the ASLIB Electronics Group, London. This 40-page publication lists encyclopædias and dictionaries, handbooks and year books, trade directories, book lists, periodical lists, and subject bibliographies. Other guides to sources of information are included. Available (price 15s) from R. S. Lawrie, ASLIB Electronics Group, c/o Sperry Gyroscope Division, Sperry Rand Ltd., Downshire Way, Bracknell, Berks.



H. F. PREDICTIONS SEPTEMBER

The graphs, which were prepared by Cable and Wireless Ltd., show median standard MUF, optimum traffic frequency (FOT) and lowest usable frequency (LUF) for reception in this country.

With the advancing sunspot cycle MUFs are some 5 Mc/s higher than for September 1966. The change from summer to autumn conditions further increases daytime MUFs in the northern hemisphere and produces a pre-dawn dip on all routes.

Apart from a short period around 08.00 G.M.T. on Montreal, sporadic-E is unlikely to modify the FOT.

LUFs show little seasonal change. They are calculated for commercial telegraph circuits using medium power and rhombic aerials, but they provide a general guide for all types of service.

WORLD OF AMATEUR RADIO

More Transmitting Licences

DURING the year ended June 30th the number of amateur transmitting licences in the U.K. increased by 964, reaching a total of 15,398. Of this number 14,610 (compared with 13,854 a year earlier) were Type A sound licences of which 2,302 (2,110) were for mobile operation. Type B sound licences, permitting operation on telephony only on 420 Mc/s and above, totalled 605 (compared with 402) of which 15 (5) were mobile. Television licences at the end of June were 183, an increase of five during the year.

Another class of licence in which there has been considerable growth during the past few years is for the radio control of models. The June 30th figure was 11,621 compared with 9,653 at the same date last year and 8,141 a year earlier.

V.H.F./U.H.F. Beacon Station in Rhodesia

INSTALLED at a site 50 miles north west of Salisbury, Rhodesia, on a mountain peak 5,600 feet above sea level, a new v.h.f./u.h.f. 100 W beacon—known as the Steve Wright Memorial station—has come into operation using the call sign ZE1JZA. The main purposes of the beacon are to (a) provide transmissions for a propagation survey to be carried out by radio amateurs in Rhodesia and possibly South Africa by recording signal levels on the two operating frequencies of 144.016 and 432.048 Mc/s separately or simultaneously, and (b) enable v.h.f./u.h.f. enthusiasts to set-up and adjust their equipment for optimum results.

Although the likelihood of the beacon being consistently heard in Europe is remote, meteor scatter, tropospheric bending and other forms of freak conditions make reception at great distances possible.

The original concept of the beacon came from the Council of the Radio Society of Rhodesia who were aware that a sum of money had been donated by Mr. Peter Lowth, ZE7JX, for the purpose of establishing a memorial to the late Steve Wright, ZE1JZ, of Bulawayo who, until his death a few years ago, had been an active v.h.f./u.h.f. worker. The construction of the beacon transmitter and aerials has been the task of many members of the Society. Modulation is by f.s.k. ≯300 c/s on 144 Mc/s and ≯900 c/s on 432 Mc/s. Reception reports should be sent to ZE1JZA, c/o Radio Society of Rhodesia, P.O. Box 2377, Salisbury, Rhodesia.

Finland's 50th Anniversary of Independence.—This year Finland celebrates the 50th anniversary of its independence as a nation and to mark the occasion the country's 52 recognized amateur radio club stations will be authorized to use the special country prefix OF (instead of OH) during the 50-day period from October 18th to December 6th. Club stations using OF calls will issue special QSL cards (embracing the symbols of the Golden Jubilee year) to confirm contacts and reception reports. The OF activity will commence at 00.01 local time on October 18th and end at 24.00 local time on December 6th—Independence Day. Local time in Finland is two hours ahead of G.M.T.

Norway Leads the Way.—Norway is the first Scandinavian country to enter into reciprocal licensing agreements with other administrations. The first agreement was signed with the United States and negotiations are continuing with Belgium, Denmark, Finland, France, Spain, West Germany and the United Kingdom. In advance of formal agreements being signed, amateurs from Denmark, Sweden and West Germany have been authorized to operate from Norwegian territory and a British subject permanently resident in that country has been issued with a transmitting licence and the call LAØAA.

I.A.R.C. Convention.—The Annual Convention of the International Amateur Radio Club opens on September 22nd in the I.T.U. Building, Geneva. The programme will include a visit to the Club station 4U1ITU, a session devoted to the reception of reports from national amateur radio society representatives and a technical session during which the Director of the C.C.I.R. (Jack Herbstreit, WØIIN-HB9AJI) is due to speak. Other speakers will discuss earth-moon-earth (moonbounce) amateur communication, amateur communication via satellite and amateur teleprinting developments. Guests from abroad will include the assistant general manager of the A.R.R.L. (Richard Baldwin, W1IKE) and representatives of the American Project OSCAR Association. The registration fee has been fixed at 20 Sw. Fr ($5 U.S.) and forms are available from I.A.R.C., P.O. Box 6, CH-1211, Geneva 20.

Scandinavian Activity Contest 1967.—The telegraphy section of this annual contest will start at 15.00 G.M.T. September 16th and end at 18.00 the next day with the telephony section following a week later at the same hours. Non-Scandinavians will attempt to work with as many Scandinavian stations as possible, one contact only being permitted to count for points on each band (3, 5, 7, 14, 21, 28 Mc/s). Responsibility for organizing the 1967 Contest is being undertaken by the Finnish National Amateur Radio Society, S.R.A.L. P.O. Box 10306, Helsinki, 6, from which address full details can be obtained. Completed log sheets must be mailed before October 15th. The prefixes considered to be in Scandinavia for the purposes of this contest are LA (Norway), JW (Svalbard), JX (Jan Mayen), OH (Finland), OHØ (Aland Islands), OX (Greenland), OY (Faroes Islands), OZ (Denmark) and SM/SL (Sweden).

European OSCAR Satellite.—According to the Project OSCAR Association of America tests and evaluation of the European OSCAR satellite are proceeding slowly because work has been delayed by the time required to exchange correspondence with the German amateur responsible for the initial construction. For this reason a launch is not yet imminent.

Amateur Radio in Bulgaria.—The Central Radio Club of Bulgaria has about 3,600 members, 640 of whom are licensed and three classes of licences are available to anyone over the age of 18 years. The distinction between licence classes is Morse code speed and maximum input power. Class A requires 20 w.p.m. and allows the use of 1 kW, Class B requires 16 w.p.m. and permits 250 W, Class C requires 12 w.p.m. and allows only 50 W. For all classes of licensee operation on all Region I amateur bands from 3.5 to 144 Mc/s is permitted except that in the first named band operation is restricted to the segment 3.5-3.65 Mc/s.

New I.A.R.U. Member Societies.—The Faroese Amateur Radio Society and the Malta Amateur Radio Society have been elected to membership of the International Amateur Radio Union. F.R.A. has about 80 and M.A.R.S. about 50 members, half the members of both societies being licensed radio amateurs.

First England-Denmark Contact on 23 cm.—The first two-way amateur contact on 23 cm (1,300 Mc/s) between England and Denmark took place on June 16th, between Peter Blair (G3LTF), of Galleywood, Chelmsford, Essex, and P. M. Varming (OZ7SP), near Copenhagen. Reports were 599 in both directions with rapid fading.

Beacon Station in the Faroes.—A new beacon station (OY3VHF) operating from the Faroes on 145.26 Mc/s has been heard as far south as The Netherlands (PAØLB) at up to 3 dB above the noise level.

JOHN CLARRICOATS, G6CL

NEW PRODUCTS

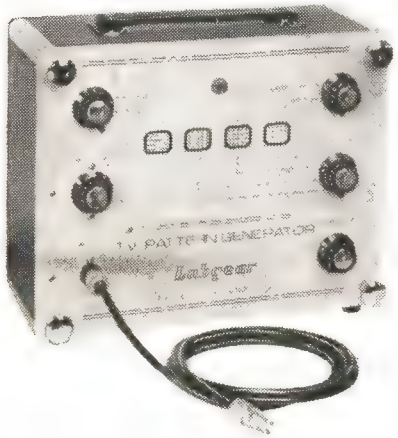
Network Analyser System

SWEEP tests for gain, phase, impedance, admittance and attenuation from 110 Mc/s to 12.4 Gc/s can be carried out with the Hewlett Packard network analyser system. Magnitude and phase of all network parameters can be presented in any one of three forms: (a) phase and amplitude relation may be read directly by meter, (b) swept phase and amplitude responses simultaneously versus frequency on a conventional oscilloscope, and (c) on a c.r.t. plug-in for swept polar displays of phase and amplitude. Smith chart overlays are provided for direct impedance or admittance read-out on the polar display unit. This system samples the signals to be compared, produces 20 Mc/s replicas and measures their amplitude and phase relationships. The sampling principle used for heterodyning, with high-gain i.f. amplifier, results in high sensitivity. Two essential tests for complete performance characterisation are (a) transmission and (b) reflection. The transmission tests define the effect which the whole device (component, circuit element or whole circuit) will have on the signal passed. Reflection tests reveal matching and interfacing relations within and surrounding the device. Hewlett Packard Ltd., 224 Bath Road, Slough, Bucks.

WW 301 for further details

PATTERN GENERATOR

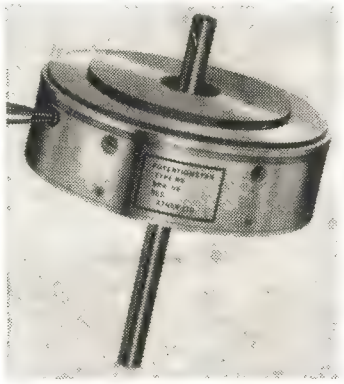
OPERATING on six U2 batteries, and weighing only 6½ lb, the Labgear E5180 pattern generator is intended for use in the adjustment of colour television receivers. This solid state instrument will not only provide the necessary crosshatch pattern for convergence checking, but it will also provide facilities for centralization, width, height, and linearity adjustments of picture before convergence checks are made. The four controls on the front panel are: 405/625 line standard selector; pattern selector for crosshatch or dot pattern, vertical or horizontal lines; pattern stability control; and adjustment of r.f. carrier frequency. Tunable channels are 6 to 13, and 26 to 52. Power consumption is 1.1 W. Price £75. Labgear Ltd., Cromwell Road, Cambridge.



WW 302 for further details

Six-gang Potentiometer

A RANGE of single-turn potentiometers by Ether Ltd., known as the 4004 series, are able to accommodate up to six gangs with an accuracy of alignment between gangs of ±1%. Resistance range available is from 1 Ω to 100 kΩ Resistance accuracy is ±3%, and independent linearity is said to be as high as 0.05%. Typical resolution for 1 kΩ is 1,500 turns and for 5 kΩ it is 3,000 turns. This range of potentiometers will operate in ambient temperatures up to 100°C. General Products Division, Ether Ltd., Caxton Way, Stevenage, Herts.



WW 303 for further details

Solid State Relay

NO moving parts, no maintenance or adjustment, no distortion caused by contact bounce, bias or transit time, are some of the negative, but outstanding features of the fully solid state relay TER10 developed by the Data Handling Division of the Plessey Automation Group. It is intended to replace the Carpenter relay used in the company's telegraph equipment. However, it can also be used for electronic conversion of voltage levels, and as a general replacement for orthodox relays under specific input and local conditions. The actual switching elements are two thyristors which are switched sequentially by the input pulses. An auto transformer sends a reverse voltage pulse to switch off one thyristor as the other is switched on. Should both thyristors be turned on together they are switched off, leaving the output to line, open circuit, then the next input transition restores correct signalling to the line. Isolation of input and output is provided by an output transformer. TER10 will operate with supplies of 75 to 100 V. Plessey Automation, Poole, Dorset.

WW 304 for further details

DIGITAL MODULE KITS

TWO series of digital module kits have been introduced by Digital Equipment Corporation (U.K.) Ltd. These are intended to provide easily assembled common logic functions such as up-down counting, decoding, digital-to-analogue and analogue-to-digital conversions, and computer interfaces. The two series will be Octaid (containing up to eight standard flip-chip modules) and Panelaid (containing up to 64 modules). Each kit contains modules, connectors and printed circuit back panel wiring. Input/Output buffer kits are available to act as interfaces between Octaid kits or specially designed systems. Digital Equipment Corporation (U.K.) Ltd., 3 Arkwright Road, Reading, Berks.

WW 305 for further details

Ferrite Core Store

MOUNTED on a single printed circuit card, and measuring $12 \times 12 \times \frac{1}{8}$in is the Trend Electronics 1024-bit ferrite core matrix, complete with address decoders, read/write drive circuits, and a sense amplifier. Access is random, and the logic levels are "1" 0 to -0.750 V, and "0" is greater than -6 V from 1.5 kΩ. Address selection for both X and Y is 5 bits (10 wire normal and inverse). Read/write cycle time 4 μs. Operating temperature range 0 to 55°C. Supply requirements are 12 V positive at 1.5 A peak, and 12 V negative at 10 mA. For integrated circuit version, 5 V positive is required. The price is £150. Trend Electronics Ltd., St. John's Works, Tylers Green, Nr. High Wycombe, Bucks.

WW 306 for further details

Radar Sheet

FOR use in microwave aerials, this material known as radar sheet is constructed from a large number of parallel wires (0.010 in diameter soft, high-conductivity copper wire) with 0.080 in wire spacing. The backing material can be glass cloth 0.005 in thick, polystyrene foam, polyester non-woven tissue 0.003 in thick or polyurethane foam. The polystyrene foam backing is 3 mm and 5 mm thick. These backings are easily cut and shaped and experiments are still being carried out using different wire spacings and other backing materials. Maximum width of sheets presently available is 36 in and in lengths of 4 ft and 8 ft. National-Standard Co. Ltd., Stourport Road, Kidderminster, Worcs.

WW 307 for further details

Tape Cassette Mechanism

CASSETTE player mechanisms operating at a speed of $1\frac{7}{8}$ in/s are to be manufactured by Garrard Engineering Ltd. When a cassette is inserted into the slot of the player mechanism, it triggers a sequence of events, switching on unit, playing the tape, stopping motor, ejecting cassette and switching off. The electronic stop and eject system prevents cassette ejection before the motor stops and all the tape is released from capstan and pinch rollers. Apart from normal automatic operation, the unit can be stopped, and the cassette rejected immediately, by a manual control. The mechanism works vertically or horizontally, and it is driven from 110/220 V 50/60 c/s mains voltage or from the batteries specified for players using either silicon or germanium devices. Wow and flutter are said to be better than 0.5% and the speed with a battery motor is kept within 3% of nominal at room temperature. The basic unit is also being developed for use as a cassette auto-changer, whereby cassettes may be added to the stack or the playing order altered without affecting the tape being played. Garrard Engineering Ltd., Newcastle Street, Swindon, Wilts.

WW 308 for further details

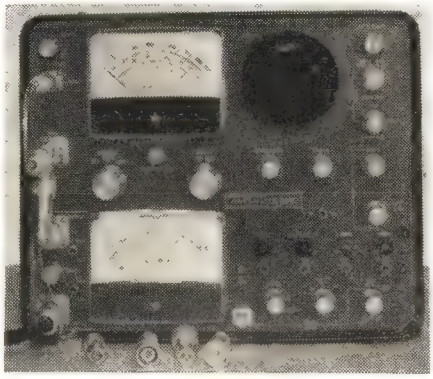
Tachometer

FOR the measurement of linear and rotary speeds, a range of industrial tachometers is being manufactured by Sapphire Research and Electronics Ltd., Ferndale, Rhondda, Glam., Wales. This range of instruments—the 500 series—is available with either electromagnetic or photo-electric transducers. Transducers may also be used for control or display purposes in converting signals of alternating nature to d.c. voltage or current. The units with associated meters can be calibrated for use as frequency meters, or rate of flow meters.

WW 309 for further details

TRANSMITTER ANALYSER

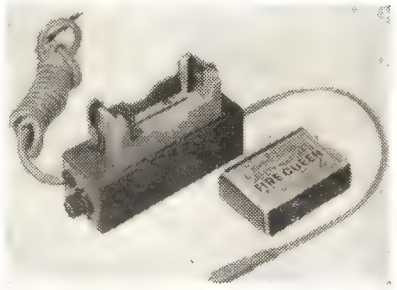
THE TG-2400 is a transmitter output analyser by Green Electronics & Communications Equipment Ltd, 79-81 Braemar Road, London, N.15. The following functions can be carried out over a wide range of r.f. power and frequencies; transmitter output power dummy load wattmeter; v.s.w.r. indicator (with frequency range of 1.8 to 3.5 Mc/s) accuracy ±15%; two-tone oscillator, transmitter output envelope display monitor and oscilloscope. The frequency range is 2 to 500 Mc/s, which can be extended to 2 Gc/s, and the maximum power rating 1 kW peak. The wattmeter has an accuracy of ±5% from 2 to 150 Mc/s and ±10% from 150 to 500 Mc/s. Output impedance is 10 kΩ and input impedance 52 Ω. The price is £290.



WW 310 for further details

Miniature Battery Charger

ORIGINALLY designed to recharge the batteries in an ultrasonic torch for the blind, is a miniature ($4 \times 1\frac{3}{8} \times 2\frac{1}{2}$ in.) battery charger by Stoneleigh Electronics Ltd., Romford, Essex. A constant-current charger, it has a solid-state stabilized circuit and will charge (without switching) one or two 9 V nickel cadmium batteries at a constant current of 15 mA ±0.5 mA with a ±50 V swing on the input or any variations in the battery voltage. It has a mains transformer isolated input circuit.

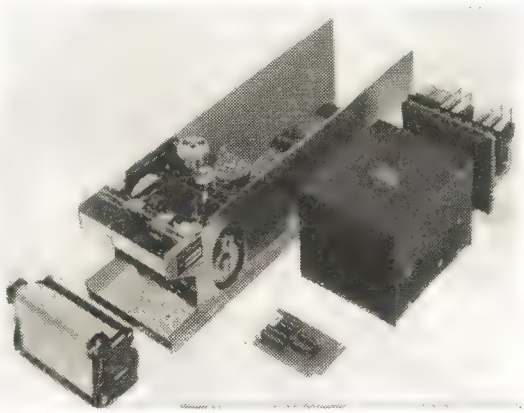


WW 311 for further details

Potentiometer Recorder

ALL the major component parts of the Jaquet potentiometer recorder are available in plug-in or clip-on form, so that they can be exchanged either in one instrument or between different instruments. These major parts include chart magazine, chart speed gears, amplifier and measuring circuit unit, range cards, range and channel distribution unit. The measuring circuitry permits the instrument to record from various types of input. This allows recording of mixed inputs simultaneously with up to six channels. The recording chart width is 100 mm and the accuracy is ±0.5% f.s.d. The response is one second f.s.d. (maximum). Input impedance is 20 kΩ. Radiotron, 7 Sheen Park, Richmond, Surrey.

WW 312 for further details



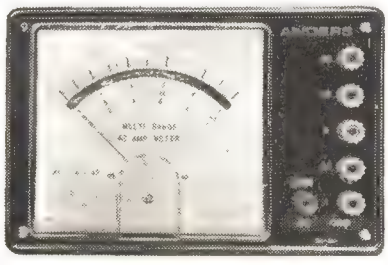
High Sensitivity Television Camera

A NEW television camera system Type OA.1705 by Marconi Instruments Ltd., employs a highly sensitive camera tube, the Isocon (developed by the English Electric Valve Co. Ltd.), to present details, which because of the low incident light are difficult or impossible to perceive with the human eye. The information can be reproduced on television monitors for direct viewing or recording. Apart from its obvious applications in the military and industrial fields, this system—which is the result of extended development of a medical image intensifier—has been used in astronomy to record on cinefilm, details of the Milky Way. The OA.1705 consists of three units. An image detection unit (including the Isocon tube), which feeds into a master control unit, where the information is processed into a complete video signal conforming to C.C.I.R. standards. The output from this unit is then passed to a monitor which normally possesses a raster with 1:1 ratio. Cine and still-photo recording units are available as well as video tape facilities. Marconi Instruments Ltd., St. Albans, Herts.

WW 313 for further details

Single Function Meters

MOVING-COIL meters designed to operate as single-function multi-range instruments are available from Anders Electronics Ltd. Uncluttered scales,



simple circuitry and switching, reliability, and reasonable prices are said to make this SM range of instruments desirable for educational and other institutions. All meters have a 3.5in mirror scale. The instruments in the range include a.c. and d.c. milliammeters, ammeters and voltmeters and a d.c. microammeter. The microammeter (SM-301) covers 50 to 1000 μA in five ranges selected by rotary switch. The a.c. ammeter (SM-361) covers 1 to 25A in five ranges selected by terminals, and it incorporates a current transformer. Accuracy on d.c. models is within 1.5% of f.s.d., and on a.c. models it is within 2.5% of f.s.d. With the exception of the two ammeters, all models are fitted with a varistor protection device permitting 50% overload on the movement. Prices range from £8 to £9 15s. Anders Electronics Ltd., 103 Hampstead Road, London, N.W.1.

WW 314 for further details

Thermoplastic Hinge

ONE-PIECE extruded piano type hinge which can be cut to any length and attached by nailing, screwing, stapling or other mechanical means, and known as Polyhinge, is available in white, blue, black, or metallic grey. It is resistant to acids, oils, and grease and is also weatherproof, watertight, and non-conductive. Available—with pre-punched holes or slats—in continuous lengths or pre-cut to any specific size, and in a variety of profiles. Herzbi Ltd., 16 Northwold Road, London, N.16.

WW 315 for further details

MATRIX DRIVERS

PLANAR epitaxial transistors BSX60 and BSX61 by Mullard have primary applications as drivers for one and two microsecond computer stores. Both transistors have a V_{CBO} of 70 V, an I_{CM} of 1 A, and a P_{tot} (at 25°C) of 800mW. The switching-on time for the BSX60 is 40 ns and for the BSX61 it is 50 ns. The f_T minimum in both cases is 250 Mc/s. It is stated that they are suitable for use with the largest ferrites now in use in matrix stores. Mullard Ltd., Mullard House, Torrington Place, W.C.1.

WW 316 for further details

Microwave Power Meter

FOR monitoring microwave power over the band 10 Mc/s to 12.4 Gc/s, a miniature microwave power meter with amplifiers has been produced by the General Microwave Corporation, U.S.A. Model 462 offers a choice of three power heads, with seven full-scale ranges covering from 100 μW to 100 mW with an accuracy of ±2% on the low range and 1± % on medium and high ranges. Instrument Division, Livingston Laboratories Ltd., Greycaine Road, North Watford, Herts.

WW 317 for further details

S.S.B. Crystal Filter

FOR use in a.m. communication equipment the FC-17-U crystal filter is said to possess carrier and adjacent sideband suppression to a degree not generally attainable. Carrier attenuation is stated to be 50 dB minimum while suppression of unwanted sideband is 65 dB minimum from -200 c/s to -75 kc/s. The carrier frequency of the unit is 1.65 Mc/s, and the passband at 3 dB is +300 c/s to +3 kc/s. Nominal impedance is 12 kΩ. Transitron Electronic Ltd., Gardner Road, Maidenhead, Berkshire.

WW 318 for further details

Firing Angle Meter

THE Westinghouse CTS1 meter for measuring the firing angle of thyristor gate drive circuits is said to provide a more convenient and direct method of obtaining a steady state indication than by examination with an oscilloscope. Included in the instrument is a stabilized d.c. supply which is intended to be used as a variable control voltage input to firing circuits, to determine the overall transfer characteristic. The CTS1 may be fed with the outputs of up to three firing circuits, thus easing the testing of three-phase units. Supply voltage is 240 V (+10%, −15%), and supply frequency should be 50 c/s ±10%. Input pulse signal (pulse or train) 3 to 20 V. Minimum pulse duration is 5 μs. The firing angle range is 2° to 178° and absolute accuracy is 3°. Westinghouse Brake and Signal Co., Ltd., Semiconductor Division, 82 York Way, King's Cross, London, N.1.

WW 319 for further details

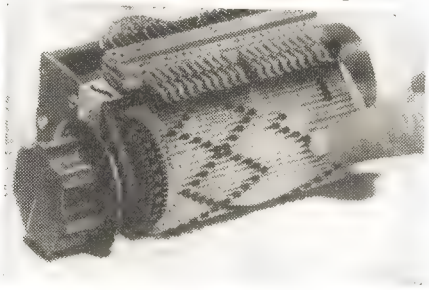
Wow and Flutter Meters

TWO Miniflux wow and flutter meters manufactured by Tech.-Phys, Munich, Germany, are available from the U.K. distributors, Lennard Developments Ltd., 7 Slades Hill, Enfield, Middlesex. The ME 102A, superseding the ME 102, has a higher sensitivity of the drift indicator (±2½%), and wow and flutter indications are 0·15 and 0·75% full scale respectively. The ME 103, for use with a wide range of turntables has a drift indicator ±4·5%, while wow and flutter meter ranges are 0·3, 1·0, and 3%. Both instruments operate on 3,150 c/s and have "flat" or "weighted" characteristics in accordance with C.C.I.R. specifications. The frequency oscillator and the measuring circuits can however, be adjusted to 3 kc/s.

WW 320 for further details

Recycling Timer

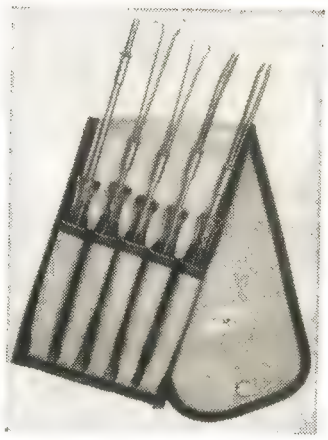
THE Actan timer is intended for applications where only d.c. supplies are available. With a d.c. motor fitted, the currents consumed for the operating voltages of 6, 12 or 24 V d.c. are 500 mA, 250 mA and 125mA respectively. Models with motor speeds of one or two r.p.m. are available, while both models can be supplied with on/off cam segments installed in increments of 0.5 seconds. Timing accuracy is ±10% of the nominal. Ten or 19 independent circuits can be controlled, with contacts rated at 2 A (resistive). Both units can be provided with a programmed stop at the end of a complete cycle or for continuous recycling operation. Sealectro Ltd., Farlington, Portsmouth, Hants.



WW 323 for further details

POSITIONING TOOLS

LOCATING small screws, nuts and other small components in places difficult to reach, can now be expedited with the kit of five positioning tools from Henri Picard & Frère Ltd., 34/35, Furnival Street, London, E.C.4. A screw positioner has a split blade, each half of which twists out of alignment to grip the walls of the screw slot. There are two positioners for nuts, bolts and washers up to 4BA sizes, and two other tools for holding leads during soldering or threading them through awkward holes. Each tool is 180 mm (7 in) long with a shank of 100 mm (4 in). The price of the kit, including plastic wallet, is 62s 8d.



WW 321 for further details

Programmable Power Supplies

SILICON devices are employed in the Belix RS power supply units. Employed in the testing of integrated circuits where a fast switching time is imperative, two of these units have a rise time of 0 to 30 V in 30μs and the three units cover 1, 2, and 5 A at up to 30 V. Their m.t.b.f. of 10^4 hours at +70°C is stated to make them particularly suitable for these applications. The outputs are fully programmable, voltage being a function of resistance and current of conductance. Input voltages are 100, 120, 220, 230, 240 V r.m.s. with permissible variation of +15%, −10% about any nominal at frequencies between 45 to 66 c/s, single phase. The Belix Company Ltd, 47 Victoria Road, Surbiton, Surrey.

WW 322 for further details

SERIES REGULATOR

WITH a regulation of 0.01% from zero to full load, the Startronic plug-in series regulator module M147 is designed to operate from a suitable rough d.c. supply. Primarily intended for use with i.cs, the maximum input voltage is 25 V d.c., minimum input voltage is 2 V more than required output. These limits include ripple. The output is 9 to 15 V d.c., 0 to 1A. Output current is limited at 1.2A to protect the module against overload and short circuit.

Maximum dissipation is 10 W at 40°C, and stability is 0.01% for ±10% change of input. The M147 is 3¾ in high excluding pins. Startronic Ltd., 117a-119a Malden Road, New Malden, Surrey.

WW 324 for further details

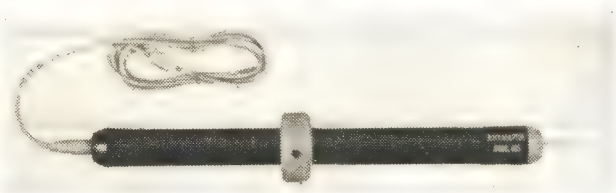
Modular Chassis

SYSTEM J modular chassis for high density packaging of circuits based on a card size of 4.750×2.530in have been designed by Imhofs. This card size can be used with 16-way×0.15 in pitch edge connectors. Two types of frame are available: (a) an open rack framework (in two sizes) accepting cards from the front, one 19 in wide and 3½ in high accommodating 32 cards, the other 22⅛ in wide×3½ in high, accepting up to 38 cards; (b) the alternative type of frame accepts plug-in modules and is available in one size 19 in wide×17½ in high. However, this frame will accept three different size plug-in modules, all of which accept cards from the top, and up to 88 cards can be accommodated in one frame. Alfred Imhof Ltd., Ashley Works, Cowley Mill Road, Uxbridge, Middlesex.

WW 325 for further details

E.H.T. Measurement

TWO high-voltage probes for the measurement of e.h.t. voltages on monochrome and colour television sets are available from Salford Electrical Instruments Ltd., Peel Works, Barton Lane, Eccles, Manchester. These models P.25 and P.30 are intended to extend the range of the Minitest and Selectest Super 50, or any other make of 20 kΩ/V multirange test instrument to 25 kV or 30 kV d.c. Maximum power consumption at full voltage on the 30 kV resistor will be 1.5 W, the unit is rated at 9 W. The probes are 13⅛-in long, plus 36 in lead, and the barrel is ⅝ in in diameter with a guard 1¾ in diameter. The price of the probes is £5 3s each for the P.25 (25 kV d.c.) and P.30 (30 kV d.c.).



WW 326 for further details

Differential Voltmeter

AS a differential voltmeter, the Model 1000 instrument by Honeywell Controls Ltd., of Brentford, Middlesex, provides ±0.0025% accurate measurement of d.c. signals with six digits of numerical readout. A seventh digit of resolution can be provided by the 10% overrange on the one- and ten-volt ranges. Potentiometric input impedances are said to provide errorless measurement of signals with high source impedances. As a decade voltage divider, the six decade Kelvin-Varley divider network is utilized, and accurate voltage level divisions can be made within ±0.001%. Operating as a ratiometer, it provides measurements within ±0.001%, while the external reference signal level may range up to ±100 V d.c. Calibrated voltage levels of six-digit resolution are obtainable when the Model 1000 is used as a precision calibrated reference source, and this operation uses the precision Zener reference and voltage divider. The output levels are selected by dialling the desired voltage on the controls. The levels ranging from 0 to 11 V d.c. are accurate to ±0.0025% and are used for the calibration of potentiometric instruments. The electronic null detector facilities possess drift-free operation and maximum reliability, due, it is said, to the use of silicon f.e.ts. Input changes as small as 10 V can be detected.

WW 327 for further details

Tape Head Maintenance Kit

INTENDED for cleaning tape heads, and other units of the tape path, of reel and cassette tape recorders, the Bib tape head maintenance kit is available from Multicore Solders Ltd., Multicore Works, Marylands Avenue, Hemel Hempstead, Herts. The kit is made up of tape head applicator tools, two tape head polisher tools, ten applicator and polisher sticks, one double ended brush, one bottle of instrument cleaner, one pocket of cleaning tissues and a five-page instruction folder. The price is 12s 6d, and replacements for different items in the kit are available.

WW 323 for further details

VHF Direction Finder

DEVELOPED for small airports, the portable direction finder Type NP8 by Rohde and Schwarz is a solid-state table set weighing about 66 lb. It is a wide aperture set operating on the Doppler principle, and, by using a suitable control crystal, it is possible to set frequencies in the range 117.5 to 135.5 Mc/s. Bearing accuracy of ±1° places this finder in Class A of C.C.I.R. recommendations for bearing accuracy and position specifications. The circular aerial reference plane is segmented, enabling simple, speedy assembly. Once the operating frequency is set the system operates automatically. Three digital indicator tubes indicate true bearing and direction is shown by 36 indicator lamps. A built-in speaker permits monitoring of the tuned-in transmitter without extraneous noise. Rohde and Schwarz, Pressereferat 8000 München 8, Mühldorfstrasse 15, Germany.

WW 329 for further details

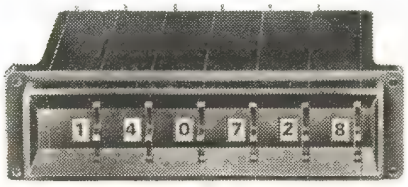
Ni-Cd Cell Charger

A PORTABLE, universal charger for nickel cadmium cells and batteries is available from Cadmium Nickel Batteries Ltd., Spedant Works, Park Royal Road, London, N.W.10. Three models of the Voltabloc CC are offered with the respective output ranges of 10 to 20 mA, 10 to 750 mA and 100 to 1000 mA, while the output remains constant irrespective of input or load variations. The three units can be connected to an input of 90-130 V or 200-250 V, 50/60 c/s. A light will indicate wrongly connected cells, or a short circuit.

WW 330 for further details

Edge-operated Switch

REQUIRING a panel cut-out of only 0.96×0.5 in, the "Miniswitch" is a single-pole eight- or ten-way unit, operated by an edgewise thumbwheel.

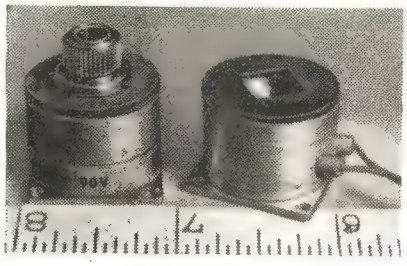


Offered by Digitizer Techniques Ltd., Banner Works, Rock-a-Nore Road, Hastings, Sussex, it will also be available in binary coded decimal form at a later date. Mounting accessories available are end cheeks to complete a bank of switches (see illustration) and to permit panel mounting. Output connections can be either wires soldered to the printed circuit board, or by means of a 0.75in pitch printed circuit edge connector.

WW 331 for further details

Electromagnetic Brakes and Clutches

VARLEY miniature brakes and clutches manufactured by Oliver Pell Control Ltd., have a rated static torque of 2 lb/in. The diameter of both the electromagnetic brake MB7 and clutch MC7 is less than 1 in. Brakes and clutches possess a stationary coil housing which magnetically attracts an armature sliding on a square section of the shaft to be coupled or controlled. The clutch also



has a rotor. Coils are rated at 3.5 W at 28 or 90 V but designs for up to 100 V can be produced. Coils are epoxy resin encapsulated. Oliver Pell Control Ltd., Cambridge Row, Woolwich, London, S.E.18.

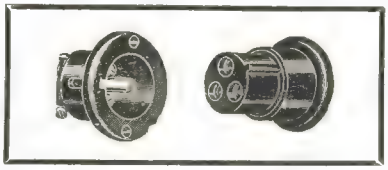
WW 332 for further details

The U.K. agents (Guest Electronics Ltd.) for the S.6A multimeter (p. 409, August issue) state that the price of this instrument is now £10 5s.

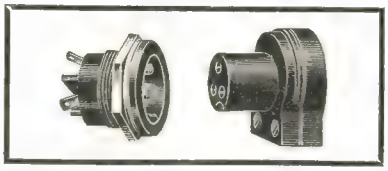
"The Choice of Critics" REGISTERED TRADE MARK

THE HOUSE OF BULGIN
AT YOUR SERVICE

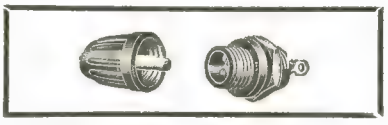
PLUGS & SOCKETS ALL ORIGINAL DESIGNS



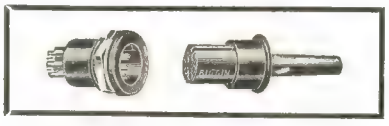
List No. P.73
Three-pole 250V.~. 5A. polarized connector, also available as a two-pole List No. P.74.



List No. P.360/SE
Miniature three-pole connector rated 250V.~1.5A. with side cable entry to socket.

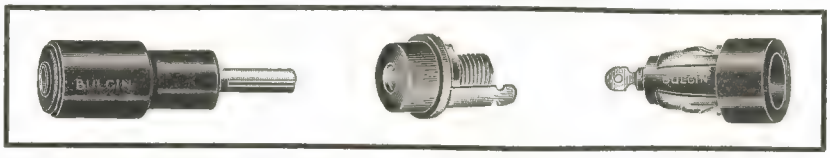


List No. P.485 + P.486
Single-pole screw locking connector, 250V.~5A. available red or black.



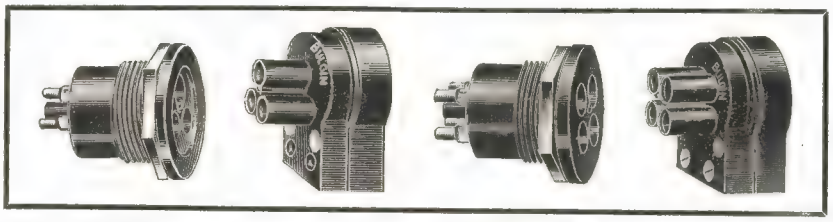
List No. P.194
Miniature six-pole, polarized connector rated 250V. ~ 1.5A. Companion model to P.360.

FOUR NEW MODELS



List No. P.46 (Plug) + **P.543** (Socket)
New single-pole connector with 4 mm. ϕ pin and socket, rated 250V. ~ 5A. available in red or black.

List No. P.542
New single-pole socket specially developed for use in *"Patch Plug Programming Systems"* accepts $\frac{1}{8}$"ϕ split pins.



List No. P.561
Three-pole fully shrouded and polarized connector miniature but rated 250V.~ 2A. side cable entry.

List No. P.560
Four-pole version of model on left, both produced from shatter resisting material.

SEND FOR OUR NEW PUBLISHED LEAFLET No. 1506/C.

A. F. BULGIN & CO. LTD.,
Bye Pass Rd., Barking, Essex.
Tel: RIPpleway 5588 (12 lines)

MANUFACTURERS AND SUPPLIERS OF RADIO AND ELECTRONIC COMPONENTS TO

ADMIRALTY	MINISTRY OF WORKS	B.B.C.
WAR OFFICE	MINISTRY OF AVIATION	G.P.O.
AIR MINISTRY	MINISTRY OF SUPPLY	C.T.A.
HOME OFFICE	RESEARCH ESTABLISHMENTS	N.P.L.
CROWN AGENTS	U.K.A.E.A.	D.S.I.R.

WW—103 FOR FURTHER DETAILS

By "Vector"

Thoughts from a Lay-by

A COUPLE of miles back along the road there is a trailer caravan, upside down and crumpled almost beyond recognition, lying beside a jumble of metal that was once a family car. On the grass verge, huddled in blankets, sit two small children, miraculously unhurt, staring numbed into a future that no longer includes their parents.

This isn't fiction; it's cold sober fact. But while (I hope) accepting it as such, no doubt you are legitimately wondering what on earth it's got to do with electronics. And that, sir, is precisely my point. It hasn't, but it ought to have.

Stand back and take a hard look at the human race in a strong light and you will surely find all the symptoms of mass lunacy. We make it virtually impossible for an ordinary citizen to own a revolver but we blandly permit almost anyone to use that equally lethal weapon the motor vehicle. We would consider it lunacy to permit engine drivers to career up and down the railway lines at their own sweet will, but we don't bat an eyelid at the sight of hundreds of thousands of car drivers doing precisely that on the roads.

Electronic control

Let's consider just one aspect of road accidents, the inter-vehicle collision, which, in spite of all road improvements, continues to keep the undertaking profession in affluent business. Here, I suggest, electronics could do a really powerful job if it were given the chance to get at the core of the trouble instead of being permitted only to dabble around on the perimeter with things like speed traps.

But before it can begin to do so we motorists must face up to some unpalatable truths which we have been sidestepping for far too long. One is that the motor vehicle is a projectile which is being controlled by its individual (and largely asynchronous) computer, namely, the human brain: another is that although, in other respects, the brain is the computer *par excellence* it simply is not designed for car driving. It is much too sensitive to far too many stimuli (and thereby to distractions) to be good at it, and the human servo-mechanisms are too sluggish to respond adequately to emergencies of the character encountered. For example, the meek little man who has just had his ears beaten off by the boss can all too easily find an emotional safety(?) valve by climbing into his jalopy and doing a Jack Brabham down the by-pass.

If we are big enough to accept this blow to our ego we are well on the way to the acceptance of better control systems; better, because they are simpler. Harness the electron to road vehicle control and it will do what it is told; no more and no less. Electronics, unlike the human computers at present on our motorways, are insensitive to bullying bosses; they have no in-law problems; and do not have to worry about where the next lot of school fees is coming from.

Is there anything so fantastic about an electronically controlled M1? If we can make electronic toys which can steer a course across the floor, dodging obstacles and homing on to a power plug when the battery needs re-charging, surely we could progress lines of vehicles up and down a straight road? If we can design an aircraft blind-landing system which exercises control in three dimensions, what can be so difficult about controlling a car in two planes only?

The buried cable is one obvious approach, having thoroughly proved itself on robot trucks and was in fact successfully tried out on a highway many years ago. Entry to the motorway might be computer-controlled, with automatic assignment to a given speed lane according to the category and condition of the vehicle. *En route*, speed and steering control would be taken over by electronics and a safe distance maintained between vehicles by the same means; should a mechanical defect occur, a "panic button" could serve to bring all cars behind to a halt until the defective vehicle was shunted to a lay-by, using the manual steering control.

By such means the traffic-bearing capacity of a motorway could be utilized to the full and it could operate equally well in fog, with no multiple crashes such as are all too common an instance today. Overtaking, that prolific cause of fatal accidents, would be eliminated.

Naturally in any such scheme, considerations of cost, and the bulk of equipment which would have to be carried, raise their ugly heads. It is here, perhaps, that microcircuits could find a mass market; the quantity of standard units should cheapen the price while the small size would solve the stowage problem. The decision-making pulses coming along the cable (or whatever means is best) would, of course, be generated in static roadside units.

Electric propulsion

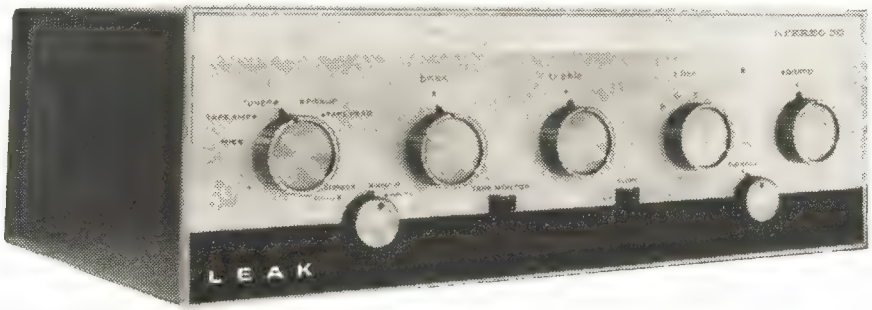
Real emancipation will come when the electric motor ousts the noisome internal combustion engine. This is more in the court of our cousins in electric traction, but if the railways can make successful use of overhead conduction I don't see why it should be impossible on the road. It would make possible the use of powerful motors and thus turn electric vehicle design away from the milk-float trend.

On the other hand, self-contained power units may still hold their own. Is it, I wonder, absolutely out of the question to scale-down nuclear propulsion units as used in submarines to road vehicle requirements? Can some timely help come from new developments in fuel cells? One hears talk also of more efficient "conventional" cells than the lead-acid type (which was used by our grandfathers and is still standard on today's cars). Given a somewhat higher capacity and a high charge rate might it not be feasible to construct charging avenues at reasonably frequent intervals along a highway through which vehicles could pass at speed, picking up energy *en route*, rather like the old express steam locomotives used to pick up water.

These are only the ramblings of an amateur or weekend driver whose only interest in road vehicles is as a means of getting from A to B in safety, comfort and in reasonable time. They will only arouse fury in the breasts of hot rod enthusiasts, but I respectfully submit that for all such, special areas should be provided (a kind of poor man's Brands Hatch?) where their talents could be exercised at no risk to anyone except their peers.

Accept then, that the suggestions made are from an ignoramus, put forward only in the hope that they may stimulate readers to produce infinitely better ones.

Britain's best Hi-Fi Equipment



STEREO 30 Transistorised integrated amplifier . . .

Superb styling, faultless performance and a breakthrough in price and reliability. Price £49.10.0

Designed to give optimum musical results from records, tape, radio and microphone, the Stereo 30 has received enthusiastic acceptance throughout the world

Reprinted from " WIRELESS WORLD " Editorial, May, 1963

" . . . Last autumn, during his presidential address to the British Sound Recording Association, H. J. Leak demonstrated a prototype high-quality transistor amplifier which gave results indistinguishable from those of his valve amplifiers . . . "

" People sometimes ask why there is any necessity to change to transistors. The elimination of the output transformer is, in our view, sufficient reason now that solutions of the problem of linearity in the response of the rest of the transistor circuit have been found. As additional bonuses we get smaller size, cooler running and the prospect of longer life."

F. M. TUNERS

MONO

Trough Line 3 **Price: £27.0.0 plus P.T. £5.3.11**

Styled to match the Stereo 30 amplifier, this unit has gained acceptance as Britain's best FM Tuner.

Designed to obtain the highest quality reception of FM transmissions, the " Trough Line 3 " is the successor of the " Trough-Line II " tuner.

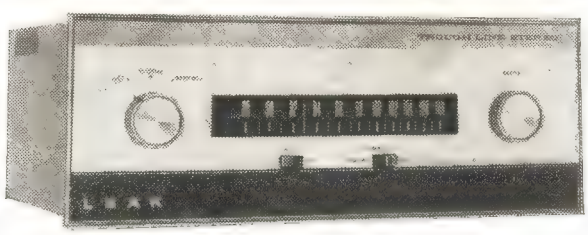
Engineering review of the Trough-Line II

" . . . Audio bandwidth is within 1 dB from 18 c/s to over 21 kc/s and distortion at 1.5V was impossible to measure on either Marconi or Heathkit Distortion-Factor meters . . . To sum up, the Leak Trough-Line II belongs to the very limited class of aristocrats in the tuner world. It has a positively astounding RF performance, impeccable limiting, ditto audio quality, and effective, but almost superfluous AFC . . . The price may appear substantial, but this is deceptive—you get a lot for your money. This tuner is definitely for the " carriage trade."

A. W. Wayne, " HI-FI NEWS "

STEREO

Trough Line Stereo **Price: £39.10.0 plus P.T. £7.12.1**



A stereo version of our " Trough Line 3 " tuner has been available for a number of years in the U.S. and Canada, where stereo broadcasting has been in existence since 1961. European Broadcasting Authorities are now using the same G.E.-Zenith System of stereo transmissions, and to enable listeners to obtain first class reception of these broadcasts we have developed the " Trough Line Stereo " Tuner. The dimensions and basic design are those of the " Trough Line 3 " with the addition of a transistorised decoder built into the chassis and with manual switching for mono or stereo operation.

LEAK THE FIRST NAME IN HIGH FIDELITY SINCE 1934.

Ask your Dealer for a demonstration, or post the coupon now for fully illustrated folders.

H. J. LEAK & CO. LTD.

BRUNEL RD., WESTWAY FACTORY ESTATE, LONDON, W.3

Telephone: **SHEpherds Bush 1173 (PBX)**

Telegrams: **Sinusoidal London W.3**

Please send me full details of Leak Hi-Fi Equipment.

Name .....

Address .....

.....

W.W.

WW—104 FOR FURTHER DETAILS

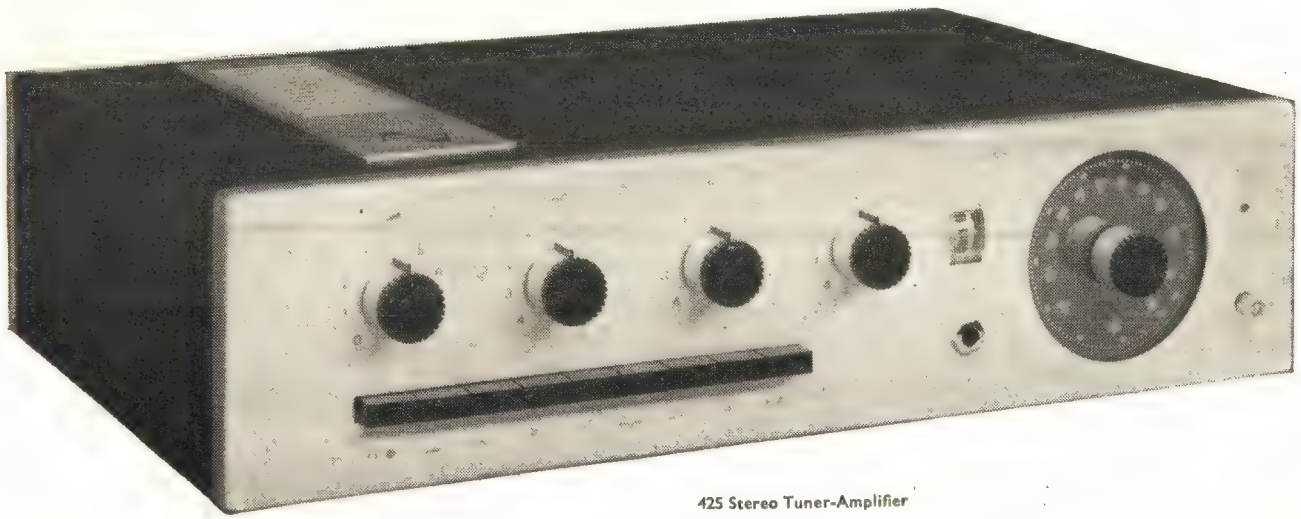
Armstrong

high fidelity sound

NEW series 400

A range of all-transistor Tuners, Amplifiers and Tuner-Amplifiers.

It's taken years in development to perfect. Years of research into whether it would be possible to better valve amplifier performance at anything like the same cost. Years of searching for the right components, the right transistors, the right design. Not just circuit design but the whole and complete concept of what we think high fidelity ought to be.



425 Stereo Tuner-Amplifier

The whole series is designed for shelf mounting or easy cabinet fitting. The attractive case, finished in rosewood laminate, serves either purpose.

Power outputs are a genuine 15 watts per channel into loudspeakers of 4, 8, AND 15 ohms. Compare the really linear power response with other amplifiers, valve or transistor. FM performance is designed to the exacting requirements of stereo radio and the sensitivity and performance on medium and long wavebands are high.

Inputs for magnetic and ceramic pickups, tape playback and radio; and such versatility, with rumble filter, two treble filters, loudness control, tape monitor, headphone listening, inter-station quieting on FM, and stereo radio indicator. A stabilised power supply and output transistor protective circuit. Plug-in modules for easy servicing. An optional plug-in Stereo Radio Decoder with gold-plated high endurance connectors. We could go on—we are very enthusiastic—but let's just list the models. For full details and technical specifications of all models plus stockists list, post coupon or write mentioning 9WW67.

Prices including purchase tax surcharge

421 Stereo Amplifier	£42-15-0
423 AM-FM Tuner	£38- 6-0
424 FM Tuner	£29-18-8
425 FM Stereo Tuner-Amplifier	£72- 0-9
426 AM-FM Stereo Tuner-Amplifier	£79- 2-9
M4 Stereo Radio Decoder	£9-10-0

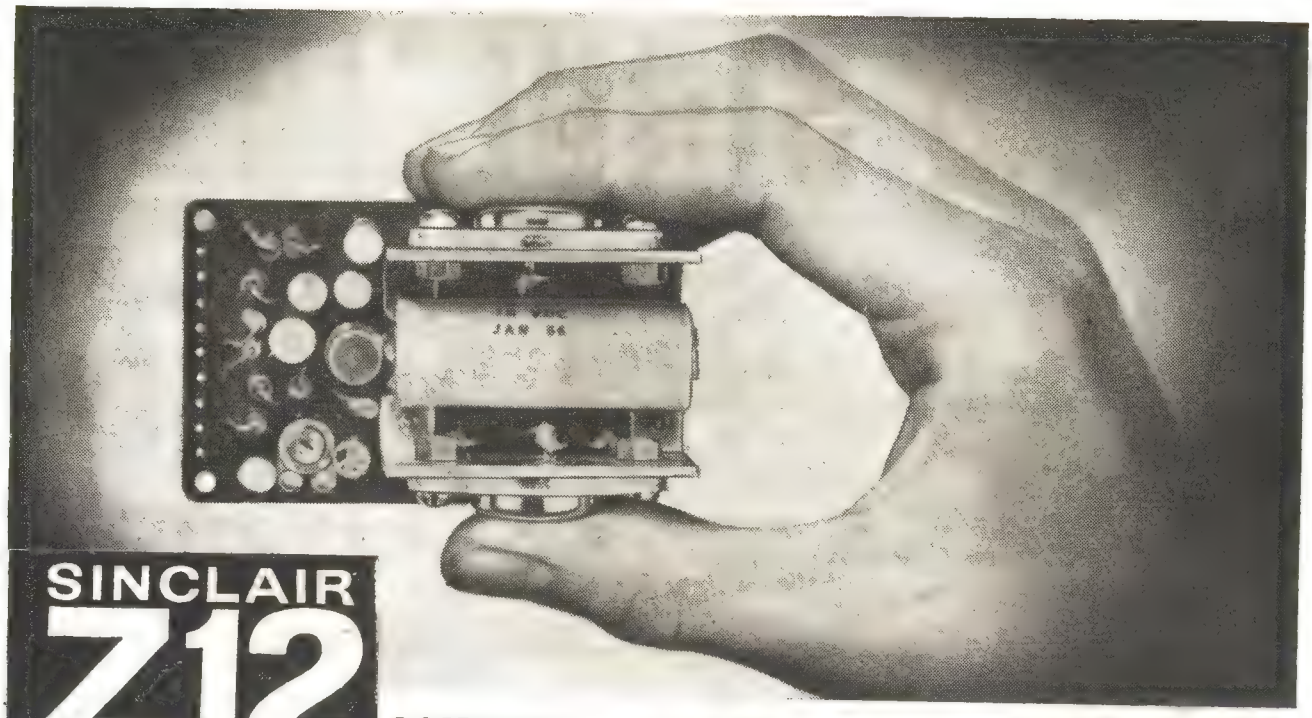
name_____

address_____

9WW67_____

Armstrong Audio Limited
Warlters Road, London, N7
North 3213

WW—105 FOR FURTHER DETAILS



SINCLAIR Z.12

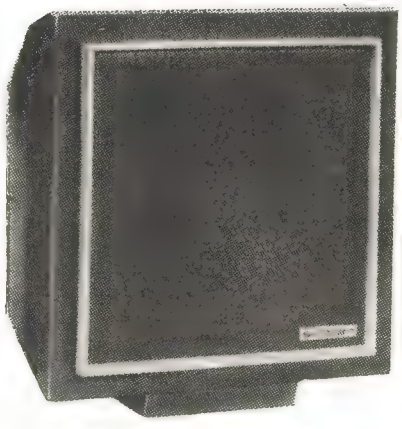
COMBINED 12 WATT HI-FI AMP AND PRE-AMP

- Ultralinear class B output
- 12 watts R.M.S. continuous sine wave output (24 w. peak)
- 15 watts music power (30 w. peak)
- Input —2mV into 2 K/ohm
- Output suitable for 15, 7.5 and 3 ohm speakers. Two 3 ohm speakers may be used in parallel
- 15-50,000 c/s ± 1dB

BUILT, TESTED AND GUARANTEED

89/6

THE SINCLAIR Z.12 has been developed to the highest possible standards for an amplifier of its size and power. Its rugged construction and amazing adaptability make it possible to use just one type of amplifier in an unusually wide variety of applications. Eight special H.F. transistors in a highly original circuit achieve standards expected of any quality amplifier, irrespective of price, yet this Sinclair unit costs a mere 89/6. The Z.12 will function efficiently from anything between 6 and 20 volts, making it very convenient to run this unit from a car battery, for example. Where it is required to run the Z.12 from mains supply, the PZ.3 is recommended. The Z.12 accepts radio, microphone and pick-up inputs; detailed instructions for connecting these in mono and stereo are given in the manual supplied with every unit. A variety of matching control networks are also given. Those wishing to have the very finest pre-amplifier and control system can connect inputs via the STEREO 25 described below. The Z.12 is supplied built, tested and guaranteed.



SINCLAIR MICRO FM

COMBINED FM TUNER RECEIVER

Less than 3in. × 1¾in. × ¾in., 7 transistor FM superhet uses pulse counting discriminator for superb audio quality. Low I.F. makes alignment unnecessary. Tunes 88-108 Mc/s. The telescopic aerial suffices for good reception almost everywhere. Signal to noise ratio —30db at 30 microvolts. One outlet feeds to amplifier or recorder, other for using set as pocket portable.

Complete kit inc. aerial, case, earpiece and instructions. **£5.19.6**

SINCLAIR MICROMATIC

THE WORLD'S SMALLEST RADIO

Fantastic A.M. receiver, tuning over M.W. Size 1⅝in. × 1 1/16in. × ½in.—smaller than a matchbox. Has amazing power, quality and selectivity. Virtually plays anywhere. Calibrated vernier type dial. Aluminium front.

Kit with earpiece, instructions and solder **59/6** *Built & tested 79/6*

SINCLAIR STEREO 25

De-luxe pre-amp. and tone control unit for two Z.12s or other quality stereo amplifier system. Input switching / treble / bass/balance and volume controls, etc. Brushed and polished aluminium front. 6½in. × 2½in. × 2½in. less aluminium knobs. Built and tested.

£5.19.6

SINCLAIR PZ.3

An advanced transistorised mains operated power supply system for two Z.12s and Stereo 25 assembly, Built and tested **79/6**

INTRODUCING THE SINCLAIR Q.14

See next pages

Turn to next pages for details and order form.

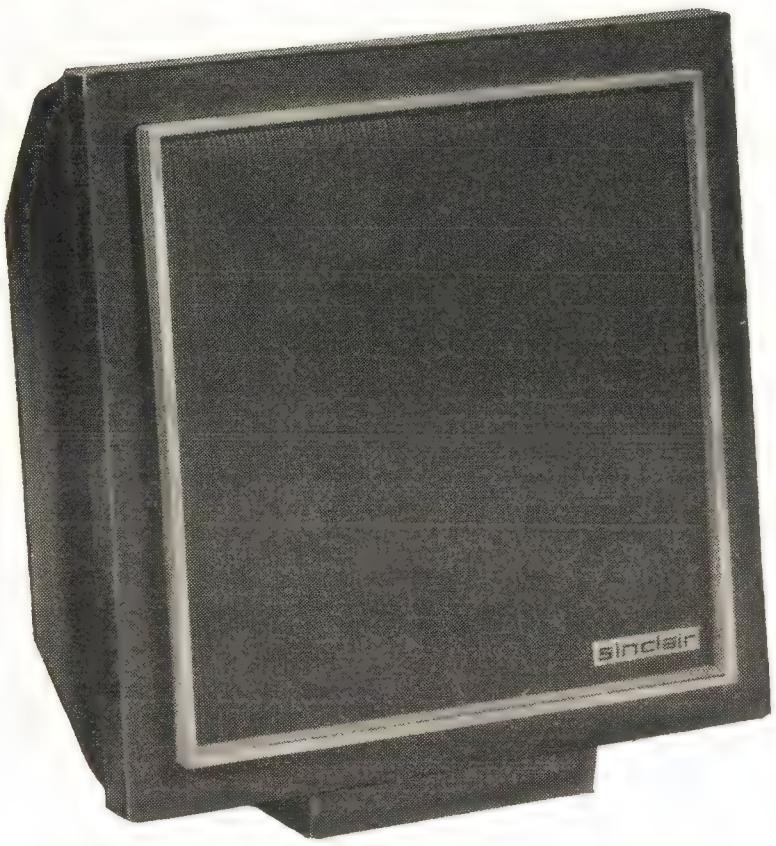
SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE

Telephone: OCA3 52996

sinclair

WW—106 FOR FURTHER DETAILS

FROM SINCLAIR - A



SINCLAIR Q.14

- ACOUSTICALLY CONTOURED SOUND CHAMBER
- WIDE ANGLE OF SOUND DISPERSION
- NEW DESIGN PRINCIPLES AND NEW MATERIALS FOR BRILLIANT TRANSIENT RESPONSE
- MAXIMUM LOADING IN EXCESS OF 14 WATTS R.M.S.
- 15 OHMS INPUT IMPEDANCE
- ALL-BRITISH DESIGN AND MANUFACTURE

THE SINCLAIR Q.14 Is an entirely new sound reproducer designed and developed in Sinclair Radionics' Cambridge Laboratories. The application of fundamentally proven acoustic principles and the use of new materials has resulted in exceptionally good standards of performance. The uniquely formed pressure chamber allows the instrument to be positioned in a variety of ways to take full advantage of the surroundings in which it will be used. Its size and form make the Q.14 far more adaptable in use than conventionally styled cabinets. At the same time, this Sinclair Loudspeaker presents a functionally elegant appearance whether used singly, in stereo or in a multiple assembly. In performance, the Q.14 compares to advantage with loudspeakers costing four or more times its price.

IDEAL FOR THE SINCLAIR Z.12

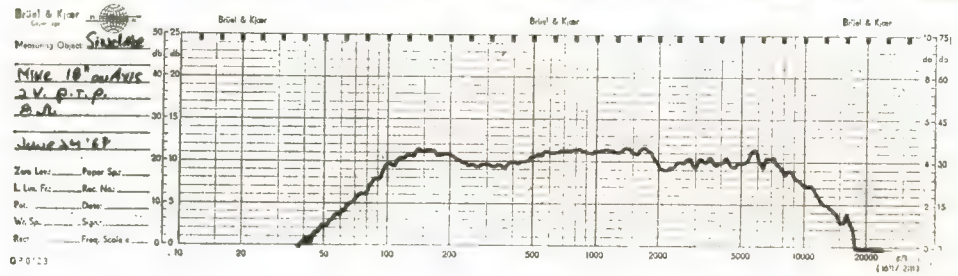
sinclair

SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE

Telephone 52996 (STD. CODE OCA3)

WW—107 FOR FURTHER DETAILS

NEW LOUDSPEAKER



This unretouched reproduction of the performance curve taken from a production model is actually better than curves from speakers costing in excess of £25.

INDEPENDENT TEST REPORT

The above curve was taken by an independent testing laboratory and shows clearly why the Sinclair Q.14 achieves such remarkable standards of reproduction. Level response is maintained to assure the user of the finest possible results from the equipment to which the speaker is coupled.

Note—curve taken against vertical 0-25 dB range and plotted on a log. scale.

DESIGN THAT ENSURES OUTSTANDINGLY GOOD REPRODUCTION

CONSTRUCTION

The sound, or pressure chamber and mounting baffle are of special high-density ultra-low resonance materials made possible by modern bonding and processing techniques. The sound chamber is of seamless construction. The drive unit is mounted to ensure freedom from spurious coloration.

LOADING

The Sinclair Q.14 has an input impedance of 15 ohms and will comfortably accept loading in excess of 28 watts music power, far greater than that required for average listening requirements. Using the Q.14 in module formation (a unique Sinclair facility) enables a very powerful system to be built up efficiently and economically for highest quality P.A. use.

FREQUENCY RESPONSE

As the independently made test curve shows, remarkably smooth response is maintained between 60 and 15,000 c/s.

DRIVER UNIT

This is a specially designed unit having exceptionally high compliance due to the method of cone suspension employed. It has a massive ceramic magnet of 11,000 gauss and aluminium speech coil, with the cone treated to ensure brilliant transient response.

CONTOURED PRESSURE CHAMBER

The shape and proportions of the sealed sound or pressure chamber have been determined mathematically to ensure maximum conversion of energy to sound with forward sounding presence and freedom from directional effect, making Q.14 ideal for stereo. Connections at rear are marked for correct phasing.

SIZE AND STYLING

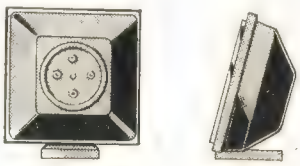
The Sinclair Q.14 measures 9¾in. square on its front face by 4¾in. deep from front to back. A separate base for free standing position is provided as well as a template for wall or flush mounting. A neat solid aluminium bar inset is used to embellish the front.

SEND FOR YOURS TODAY **£6.19.6**

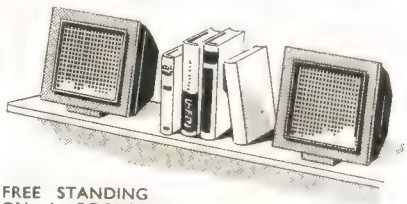
Your money will be refunded if not satisfied.

SINCLAIR GUARANTEE

If you are not completely satisfied when you receive your purchase from us, your money will be refunded at once in full and without question.

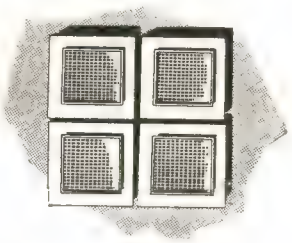


The size and form of the Sinclair Q.14 permits it to be used in a far wider variety of ways than with conventionally designed loudspeakers. This makes matching to environment easier. Here are some typical ways in which the Q.14 can be used. Other environments will suggest other ways.



FREE STANDING ON A BOOKSHELF
Ideal for stereo. The base supplied with the Q.14 is used here.

MULTI - UNIT ASSEMBLY
Any number of Q.14's can be flush mounted into a flat surface such as a false wall or room divider.



CORNER SPEAKER AT ANY HEIGHT
The Q.14 fits comfortably into a wall corner where the walls can contribute to sound dispersion to good effect.

If you prefer not to cut this page, please quote WW9 when writing your order.

SINCLAIR PRICE AND PRODUCT REMINDER

Micromatic Kit	59/6
Micromatic ready built	79/6
Micro FM Kit	£5/19/6
Z.12 Amplifier	89/6
Stereo 25 Pre-amp.	£9/19/6
PZ.3 Mains power unit	79/6
Q.14 Loudspeaker	£6/19/6

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE

Please send items detailed below:

.....

.....

.....

For which I enclose cash/cheque/money order

NAME .....

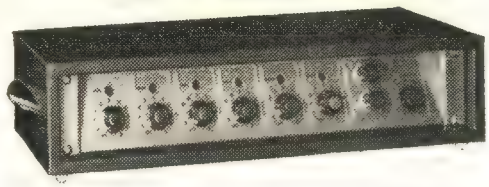
ADDRESS .....

.....

..... WW 967

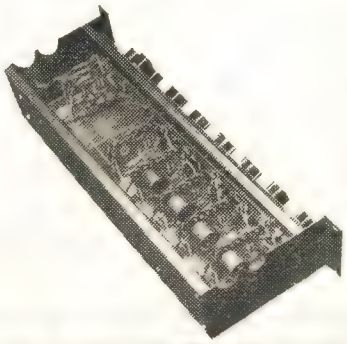
WW—108 FOR FURTHER DETAILS

Audix SOUND SYSTEMS & ELECTRONICS



MXT/6 Mixer Unit complete with Modules

- HIGH PERFORMANCE
- COMPACT MODULAR CONSTRUCTION
- RACK OR CONSOLE MOUNTING
- FIRST GRADE COMPONENTS AND MATERIALS



MODULAR AUDIO MIXERS

Assemblies, housing up to fourteen channels with combining amplifier, etc., can be supplied for either Rack or Console mounting. Power supplies, v.u. meters can be incorporated to meet individual requirements.

SPECIFICATION

Combining Pre-Amplifier MXT/6. Output Imp. 2K ohms @ 170 mV balanced, or Zero dB @ 600 ohms balanced or floating. Tone Controls: Bass: +10dB—8dB @ 100Hz. Treble: +8dB — 10dB @ 10kHz.

MIC. Module MU/30. Input Imp. 50 ohms balanced. Frequency response 50Hz-20kHz. Sensitivity: — 80 dB.

MIC. Module MU/200. Input Imp. 200 ohms balanced. Frequency response 50Hz-20kHz. Sensitivity: — 74 dB.

MIC. Module MU/1. Input Imp. 50K ohm unbalanced. Frequency response 20Hz-20kHz. Sensitivity: — 32 dB.

GRAM. Module GU/1. Input Imp. 1M ohm. Frequency response 20Hz-20kHz Sensitivity: — 16 dB.

TAPE Module TU/1. Input Imp. 100 K ohm. Frequency response 20Hz-20kHz Sensitivity: — 26 dB.

RADIO Module RU/1. Input Imp. 100 K ohm. Frequency response 20Hz-20kHz. Sensitivity: — 10 dB.

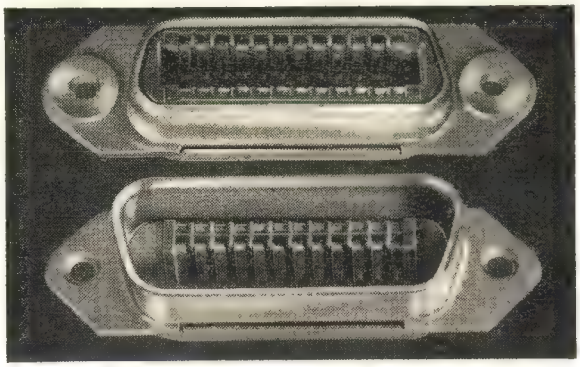
SIGNAL NOISE RATIO PER CHANNEL. Better than 60 dB.

Write for catalogue of full range of Sound Equipment.

Audix

STANSTED, ESSEX
PHONE:—
STANSTED:—3132/3437

WW—109 FOR FURTHER DETAILS



J. D. CONNECTORS

Rack and panel miniature connectors with flex-leaf spring contacts. 24, 36 and 50 way versions intermateable with existing types.

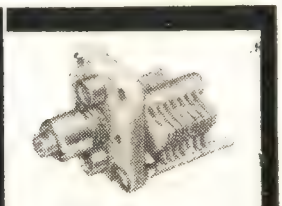
Cannon Electric (Great Britain) Ltd., Lister Road, Basingstoke, Hants. Tel: Basingstoke 3171

CANNON PLUGS
Registered Trademark

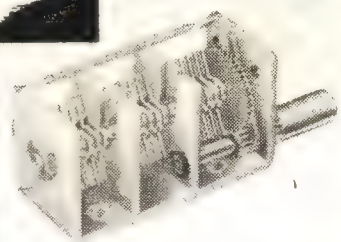
Cannon Distributor Line **CANNON**

WW—110 FOR FURTHER DETAILS

Polar



for VARIABLE CAPACITORS



TERMINAL STRIPS

LEADTHROUGH INSULATORS

WINGROVE & ROGERS LTD
DOMVILLE ROAD · LIVERPOOL 13
Telephone: Stoneycroft 2265
LONDON OFFICE: 75 Uxbridge Road · Ealing W.5. Tel: 01-567 7046

WW—111 FOR FURTHER DETAILS

PRECISION VOLTAGE AND CURRENT SOURCES WITH ACCURACY OF 0.05%

Two additions to the Bradley range of Calibrators have recently been made.

The Type 127 D.C. CALIBRATOR provides from 1mV to 509.9V d.c. at an accuracy of 0.05% ±25μV, with a current capability of 20mA.

The Type 132 D.C. CURRENT CALIBRATOR provides from 1μA to 100mA d.c. at an accuracy of 0.05% ±0.01μA, with a voltage capability of 100 volts.

Features of both models include a Percentage Deviation Indicator giving continuous variation over two ranges —1% to +1%, and —5% to +5% of output setting, with meter indication; and a Sweep Facility to vary the output from —5% to +105% of output setting, again with meter indication. Provision is made for automatic programming over the full ranges of output.

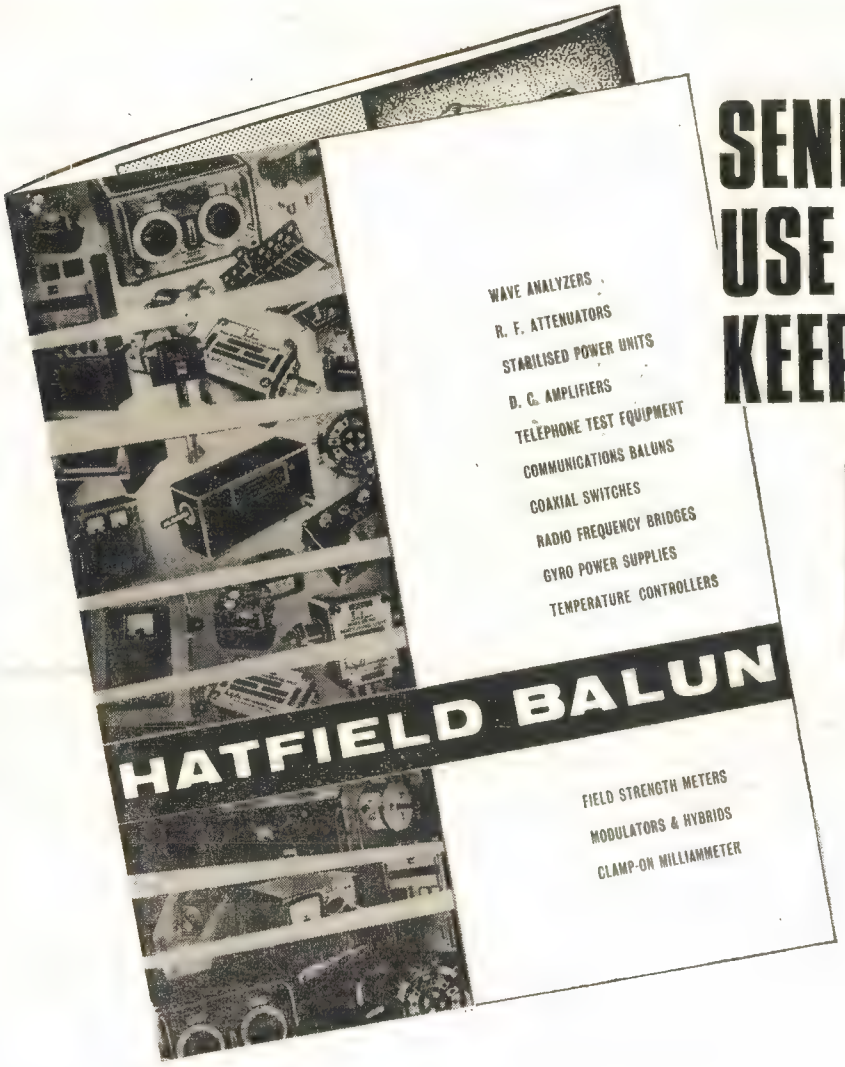
Details are given in the booklet "Calibration Equipment". May we send you a copy?

BRADLEY INSTRUMENTS

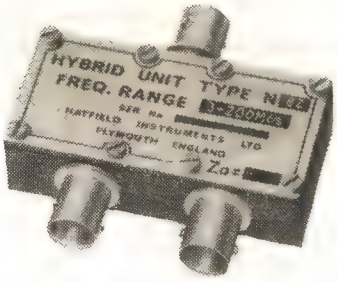
G. & E. BRADLEY LTD

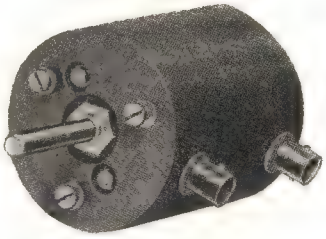
ELECTRAL HOUSE, NEASDEN LANE, LONDON, N.W.10.
TELEPHONE: 01-450 7811 TELEGRAMS: BRADELEC LONDON N.W.10.
TELEX: 25583

WW—112 FOR FURTHER DETAILS



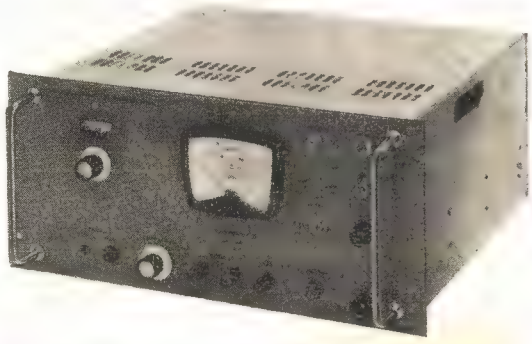
SEND FOR IT... USE IT... KEEP IT





The wide range of Hatfield Instruments and equipment has recently been extended by many items, notably the new and restyled Fixed Attenuators, Modulators, Signal Dividers and Hybrids. Make sure you have a copy of the most recent short form catalogue, together with Advance Data Sheets on the new developments.

Illustrated:
R.F. Bridge, Type LE 300/A1; one of the new Hybrids, Type N.81; the latest Type 708 Attenuator operating up to 100 MHz, and the A.C. High Frequency Power Supply, Type 594.



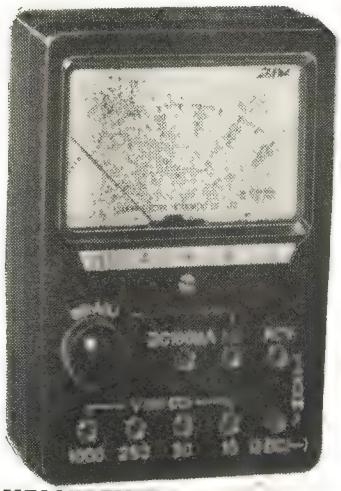
HATFIELD BALUN

HATFIELD INSTRUMENTS LTD.

Dept. WW, Burrington Way, Plymouth, Devon

Telephone: Plymouth (0752) 72773/4. *Telegrams: Sigjen Plymouth*

WW—113 FOR FURTHER DETAILS



SANWA MULTI TESTERS

USED THROUGHOUT THE WORLD, SANWA'S EXPERIENCE OF 30 YEARS ENSURES ACCURACY RELIABILITY · VERSATILITY UNSURPASSED TESTER PERFORMANCE COMES WITH EVERY SANWA.

Excellent Repair Service..

Model P-1B

62/- *Inc. Test Prods and instructions.*

MEASUREMENT RANGES:

DC V: 10 50 250 1000v (1kΩ/v)
AC V: 10 50 250 1000v (1kΩ/v)
DC A: 100ma
OHM: 0.1 ~ 100kΩ (midscale—25kΩ)
DB: −10 ~ +22db + 20~ + 36db
*μf & H: 0.001 ~ 0.1μf & 10~1000H
* use external power

ACCURACY
DC RANGES: ± 3%
AC RANGES: ± 3%

BATTERY 1.5v × 1

SIZE 2¾in. × 4in. × 1¼in.

Midget tester ruggedly built for accurate measurement. Wide measurement range makes the meter very useful for checking all sorts of electrical home appliances.

Model JP 5	£4 17 6
Model U-50D	£6 10 0
Model 360-YTR	£6 17 6
Model 380-CD	£11 10 0

PLEASE WRITE FOR ILLUSTRATED LEAFLETS OF THESE SANWA METERS

SOLE IMPORTERS IN U.K:
HOUSEHOLD ELECTRIX LTD.
47-49 HIGH STREET, KINGSTON-UPON-THAMES, SURREY
TELEPHONE: 01-546 4585

WW—114 FOR FURTHER DETAILS

The **"MIRACLE"** Range of Soldering Irons fitted with the Bi-Metal, Steel held Solid Silver Bit.

8 Models—Any Voltage.
Over 150 type bits.
6 v. to 240 v.
10 W. to 500 W.

← 70/-

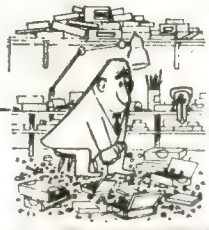
LONG LIFE BITS.
EASY BIT / ELEMENT INTERCHANGE.
NO MAINTENANCE IN USE.
PERMANENT BIT SHAPE AND SIZE.

One Customer writes: "... This iron has been in continuous use for about **EIGHT MONTHS** and it would appear that it now needs a new bit."

We claim long life
*Our customers **PROVE** it.*

LONDTRA LTD. Kelway Works, Kelway Place, London, W.14.
Tel: (01) 385 7606.

WW—115 FOR FURTHER DETAILS



It's easier...

to find small components in a transparent raaco drawer cabinet

It keeps all your transistors, bulbs, screws, bolts, nuts, etc. VISUAL, ASSORTED AND ALWAYS AVAILABLE

THE MOST COMPACT SYSTEM FOR STORAGE OF SMALL ITEMS

- see at a glance avoids searching
- heavy gauge reinforced steel frames
- transparent, dividable plastic drawers
- self-supporting, standardized units
- stackable or suspendable for speedy erection or alteration into larger sections
- more than 20 different models

FOR MODERN AND EFFICIENT STORAGE OF ALL SMALL COMPONENTS INSIST ON

raaco

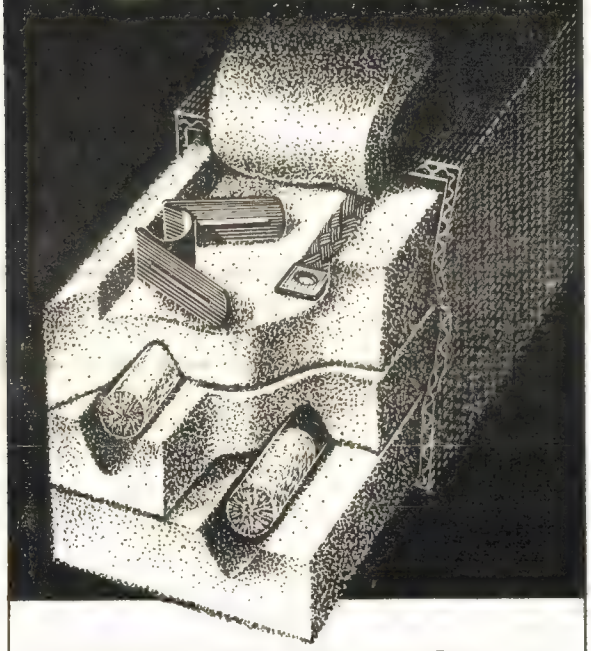
MODEL 36 A
£ 4.10.0

For detailed information and illustrated brochure write to

RAACO (London) Ltd., 52/54 High Holborn, London W. C. 1.

WW—116 FOR FURTHER DETAILS

TRANSIT PACK PROTECTION WITH FOAMAIR



Prevention is better than claim. Even your most fragile apparatus will arrive intact when packed in Foamair. A flexible urethane, Foamair gives complete protection against vibration and shock.

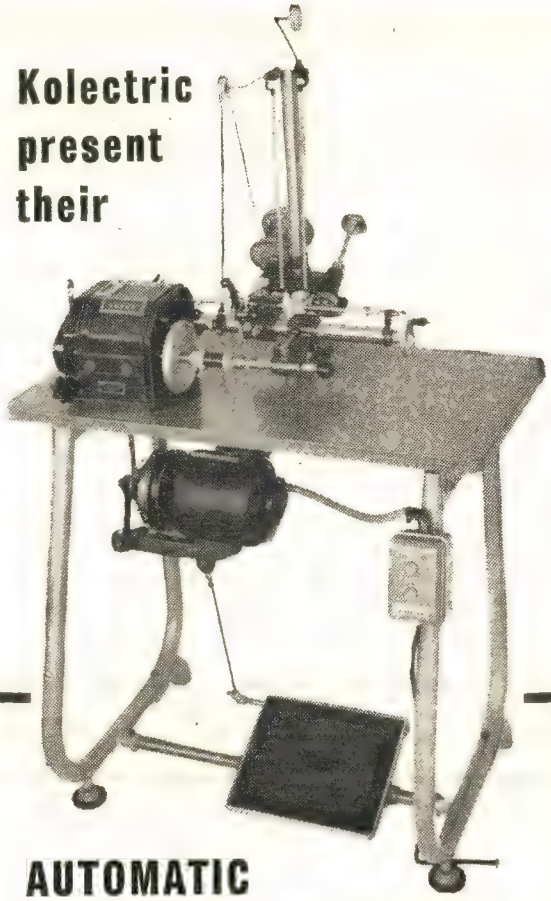
The illustration shows a highly successful transit pack designed for exporting brittle furnace elements to Russia. Commissioned by Morganite Electroheat Limited, the bespoke pack was repeatedly tested at the prototype stage: complete consignments survived four-foot drop tests on to concrete.

As it can be cut or profiled to any shape, let us tailor Foamair to your product. If you cannot risk sending it, we'll arrange to have it collected. Then we'll safely consign it back to you packed in Foamair.

FOAMAIR LIMITED
21 West Ferry Road, Millwall, London, E.14.
Telephone: EASt 5665 (4 lines)
Member of the Kayfoam group of companies

WW—117 FOR FURTHER DETAILS

Kolectric present their



AUTOMATIC COIL WINDING MACHINE

Type A1/1 (25-50 S.W.G.)
Type A1/X (19-46 S.W.G.)

incorporating ALL these refinements:

- ★ Provision for simultaneous winding of several coils
- ★ Micrometer traverse setting
- ★ Wire gauge indicator with various settings to which machine can quickly be adjusted without changing any gears
- ★ Instantaneous re-set turns counter reading up to 100,000 turns; predetermined version available
- ★ Efficient wire tensioning stand supporting one or more reels of wire
- ★ Cadmium- or chromium-plated steel parts

A fully illustrated leaflet quoting complete technical specifications is available. We will be pleased to send it to you on request.

KOLECTRIC LTD
HAYES ROAD, SOUTHALL
MIDDLESEX
Tel.: SOUTHALL 6002/3

WW—118 FOR FURTHER DETAILS

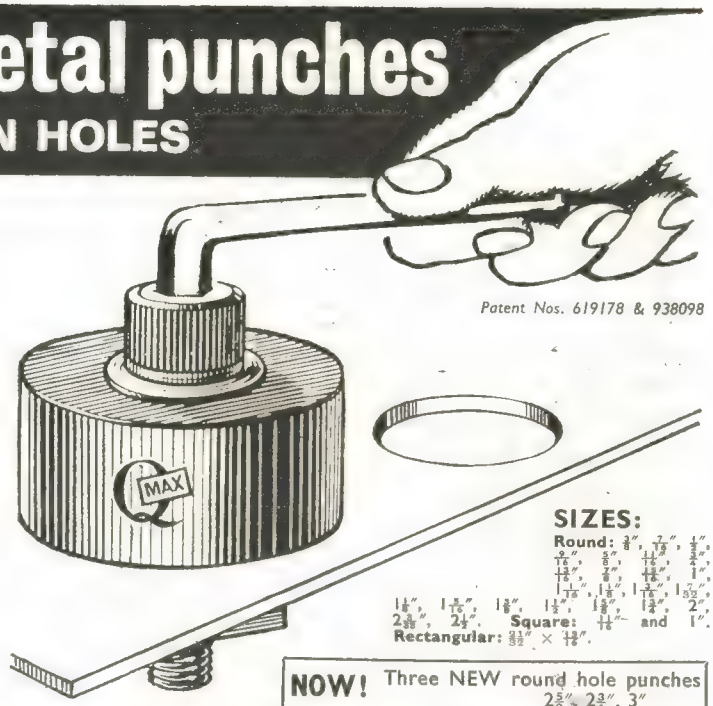
"Q-MAX" sheet metal punches
FOR QUICK AND CLEAN HOLES

- Simple operation
- Quick, clean holes (up to 16 gauge mild steel)
- Saves time and energy
- Burr-free holes—no jagged edges
- Special heat treatment maintains keen cutting edge
- Anti-corrosive finish prevents rusting
- Used all over the world

Used by all government services—Atomic, Military, Naval, Air, G.P.O. and Ministry of Works; Radio Motor and Industrial Manufacturers, Plumbing and Sheet Metal Trades, Garages, etc.

Obtainable from Radio, Electrical and Tool Dealers

WHOLESALE & EXPORT ENQUIRIES ONLY TO



Patent Nos. 619178 & 938098

SIZES:
Round: $\frac{3}{8}$", $\frac{7}{16}$", $\frac{1}{2}$", $\frac{9}{16}$", $\frac{5}{8}$", $\frac{11}{16}$", $\frac{3}{4}$", $\frac{13}{16}$", $\frac{7}{8}$", $\frac{15}{16}$", 1", $1\frac{1}{16}$", $1\frac{1}{8}$", $1\frac{3}{16}$", $1\frac{1}{4}$", $1\frac{5}{16}$", $1\frac{3}{8}$", $1\frac{7}{16}$", $1\frac{1}{2}$", $1\frac{5}{8}$", $1\frac{3}{4}$", 2", $2\frac{1}{8}$", $2\frac{1}{4}$". **Square:** $\frac{11}{16}$" and 1". **Rectangular:** $\frac{21}{32}$" × $\frac{13}{16}$".

NOW! Three NEW round hole punches $2\frac{5}{8}$", $2\frac{3}{4}$", 3"

"Q-MAX" (electronics) LTD. Napier House, High Holborn, London, W.C.1.

WW—119 FOR FURTHER DETAILS

KEYSWITCH RELAYS

vive la difference—
vive le keyswitch

It's just a little difference, but it means a lot! With Keyswitch relays, the extra attention given to details, the stringent testing at every stage of manufacture means you can be that little bit more sure of the outcome.

Relays to BPO 3000 specification—miniature or sub-miniature relays (all from stock)—it's the same difference. Get to know Keyswitch relays, you'll find you can trust them.

Type P33 plug-in version of the Keyswitch BPO 3000 Type Relay

MK2P Miniature plug-in relays, 2 and 3 pole

always to price ▷◁ always to specification ▷◁ always on time

KEYSWITCH RELAYS LTD · CRICKLEWOOD LANE LONDON, N.W.2 · Tel: 01-452 3344 · Telex: 262754

WW—120 FOR FURTHER DETAILS

When you are ready for better equipment move up to LUSTRAPHONE quality

LUSTRAPHONE

microphones : audio equipment
accessories : components : fitments

send for illustrated information

LUSTRAPHONE LTD

St. George's Works, Regents Park Road, London, N.W.1 *Telephone:* **01-722 8844**

WW—121 FOR FURTHER DETAILS

ELECTROLUBE* MEANS COSTS SAVED

Electrolube—the highly efficient completely safe electrical and mechanical lubricant is now available in both aerosol (2A-X) and grease tube (2G-X) form to improve contact performance and inhibit tarnish and sparking in all types of electronic and electrical equipment, thus minimising service and maintenance costs. Electrolube definitely improves the mechanical operation of plugs and sockets, rotary and sliding switches and all types of electro-mechanical device—giving an *extra* reliability factor to equipment and components wherever it is used.

ONLY ELECTROLUBE

Available—through wholesalers and agents all over the world—in the economical aerosol (2A-X) and grease tube (2G-X) compatible with all plastics, rubbers and paints. Also available in 1, ½, and ¼ kilo containers.

For full technical details write to:—

U.K. Enquiries: Electrolube Limited, Oxford Avenue, Slough, Bucks. Telephone: Slough 25574 Telex: Electrolube Chamcom Slough 84314

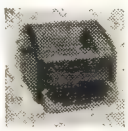
Overseas Enquiries: Electrolube Limited, 16 Berkeley Street, London W.1. Telephone: MAYfair 7654

ELECTROLUBE

* *Registered Trade Mark*

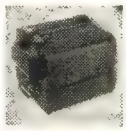
WW—122 FOR FURTHER DETAILS

TELEPRINTERS · PERFORATORS REPERFORATORS · TAPEREADERS EDITING & REPRODUCING SETS

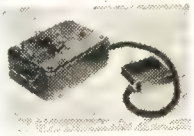


Codes: Int. No. 2 Mercury/Pegasus, Elliot 803, Binery and special purpose Codes.

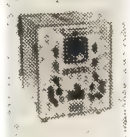
2-5-6-7-8 TRACK AND MULTIWIRE EQUIPMENT

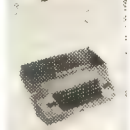


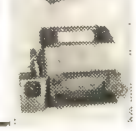
TELEGRAPH AUTOMATION AND COMPUTER PERIPHERAL ACCESSORIES



Picture Telegraph, Desk-Fax, Morse Equipment; Pen Recorders; Switchboards; Converters and Stabilised Rectifiers; Tape Holders, Pullers and Fast winders; Governed, Synchronous and Phonic Motors; Teleprinter Tables and Cabinets; Silence Covers; Distortion and Relay Testers; Send/Receive Low and High Pass Filters; Teleprinter, Morse, Teledeltos Paper, Tape and Ribbons; Polarised and specialised relays and Bases; Terminals V.F. and F.M. Equipment; Telephone, Carriers and Repeaters; Multiplex Transmitters; Diversity Frequency Shift, Keying Equipment; Line, Mains Transformers and Suppressors; Racks and Consoles; Plugs, Sockets; Key, Push, Miniature and other Switches Cords, Wires, Cables and Switchboard Accessories; Teleprinter Tools; Stroboscopes and Electronic Forks; Cold Cathode Matrics; Test Equipment; Oscilloscopes; Miscellaneous Accessories and Spares.







W. BATEY & COMPANY

Gaiety Works, Akeman Street, Tring, Herts.

Tel.: Tring 3476 (3 lines) Cables: RAHNO TRING
STD: OHH 282 TELEX 82362

WW—123 FOR FURTHER DETAILS

If you were born under LIBRA

remember there's an RTS in the month!

Your horoscope indicates a successful phase for finalising electronic prototypes. Some irritation may be caused by last minute need for components but a telephone call to RTS will restore your composure overnight. Superiors impressed.
Lucky numbers: Cambridge (OCA3) 51471—for orders
Cambridge (OCA3) 59101—other business

Send for comprehensive catalogue today to see what RTS holds in store for you.

RTS for all your components, by return, even overseas!

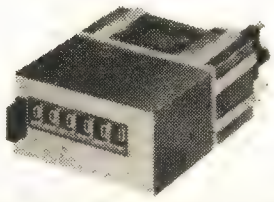
RTS

RADIO AND TELEVISION SERVICES LIMITED
P.O. Box 11, Gloucester Street, Cambridge

A MEMBER OF THE PYE GROUP OF COMPANIES

WW—124 FOR FURTHER DETAILS

THIS is what really counts

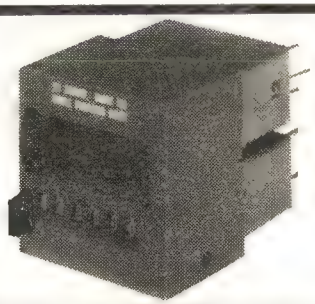


F.043 INDICATING IMPULSE COUNTER

50 i.p.s.

40,000,000 operations without loss of count

500,000,000 estimated service life



FA.043 PRE-DETERMINING IMPULSE COUNTER

25 i.p.s.

30,000,000 operations without loss of count

300,000,000 estimated service life

FULLY GUARANTEED

NOW choose HENGSTLER counters

for accuracy, reliability and guaranteed service.

J. HENGSTLER CO GREAT BRITAIN LTD.
Brooker Road, Waltham Abbey, Essex
Phone: Waltham Cross 26166-7-8

WW—125 FOR FURTHER DETAILS

RADFORD

AUDIO LABORATORY INSTRUMENTS

LOW DISTORTION OSCILLATOR (Series 2)

An instrument of high stability providing very pure sine waves, and square waves, in the range of 5 Hz to 500 kHz. Hybrid design using valves and semiconductors.

Specification

Frequency coverage:	5 Hz-500 kHz (5 ranges)
Output Impedance:	600 Ohms.
Output Voltage:	10 Volts r.m.s. max.
Output Attenuation:	0-110 dB continuously variable.
Sine Wave Distortion:	0.005% from 200 Hz to 20 kHz increasing to 0.015% at 10 Hz and 100 kHz.
Square Wave Rise Time:	Less than 0.1 microseconds.
Monitor Output Meter:	Scaled 0-3, 0-10, and dBm.
Mains Input:	100 V.-250 V. 50/60 Hz.
Size:	17¼×11×8in.
Weight:	25 lbs.
Price:	£125.

Rack mounting version available.

DISTORTION MEASURING SET (Series 2)

A sensitive instrument for the measurement of total harmonic distortion, designed for speedy and accurate use. Capable of measuring distortion products as low as 0.002%. Direct reading from calibrated meter scale.

Specification

Frequency Range:	20 Hz-20 kHz (6 ranges)
Distortion Range:	0.01%-100% f.s.d. (9 ranges)
Sensitivity:	100 mV.-100 V. (3 ranges)
Meter:	Square law r.m.s. reading.
Input Resistance:	100 kOhms.
High Pass Filter:	3 dB down at 350 Hz. 30 dB down at 35 Hz.
Frequency Response:	±1 dB from second harmonic of rejection frequency to 250 kHz
Power Requirements:	Included battery.
Size:	17¼×11×8in.
Weight:	15 lbs.
Price:	£90.

Rack mounting version available.

VOLTMETER (new item)

A transistor operated voltmeter satisfying the requirements for audio frequency measurement.

Specification

Sensitivity:	1 mV.-300 V. f.s.d. (12 ranges)
Calibration Accuracy:	2% f.s.d.
Frequency Response:	±1 dB, 10 Hz-500 kHz.
Input Impedance:	1 MOhm. 1 mV.-300 mV. 10 MOhm. 1 V.-300 V.
Meter Scaled:	0-3, 0-10, and dBm.
Power Requirements:	Included battery.
Size:	11½×6½×6in.
Weight:	7 lbs.
Price:	£35.

RADFORD ELECTRONICS LTD

Ashton Vale Road
Bristol 3

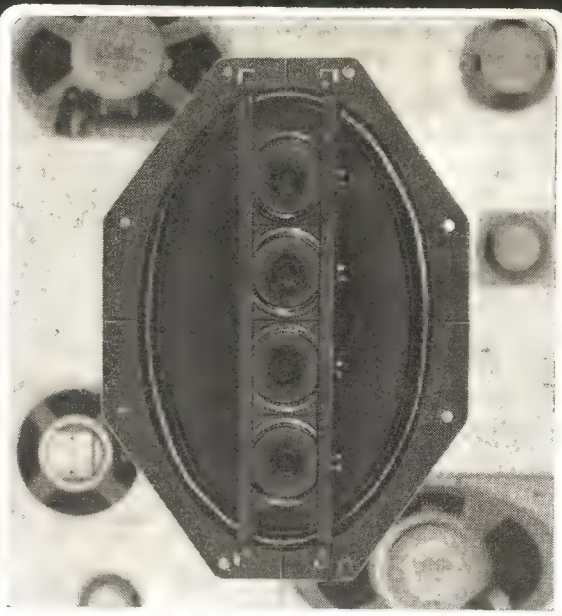
WW—126 FOR FURTHER DETAILS

BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N W.1
THE VALVE SPECIALISTS *Telephone PRIMROSE 9090*
47 NORFOLK ROAD, LITTLEHAMPTON, SUSSEX. *Littlehampton 2043*
Please forward all mail orders to Littlehampton
ALL GOODS LISTED BELOW IN STOCK

OA2	5/-	9D7	7/6	DK96	6/6	EL822	22/6	QV04/7	7/-	AF124	7/6
OB2	6/-	10C1	9/-	DL94	5/6	EM71	14/-	R10	15/-	AF125	3/6
OZ4GT	4/3	10C2	12/-	DL96	6/-	EM80	5/9	R16	34/11	AF126	7/-
1A5	5/-	10D2	11/8	DL810	10/6	EM81	6/9	R18	9/6	AF127	3/6
1A7GT	7/6	10F1	9/9	DM70	6/-	EM84	6/-	R19	6/9	AF139	27/6
1C5	4/9	10F3	8/-	DM71	9/9	EM85	11/-	SP61	2/-	AF186	20/
1D5	6/-	10F9	9/-	DY86	5/9	EM87	6/6	TDD4	7/6	AFZ12	5/-
1D6	9/6	10F18	9/-	DY87	5/9	EY51	5/6	TH233	6/9	BCY10	5/-
1H5GT	7/-	10P13	12/-	E80F	24/-	EY81	7/-	TP22	5/-	BCY12	5/-
1L4	2/6	10P14	13/-	E80CC	33/-	EY83	9/-	TP25	5/-	BCY33	5/-
1N5GT	7/9	12A6	5/-	E83F	24/-	EY84	9/6	TP2620	7/6	BCY34	5/-
1S4	4/9	12AC6	8/-	E88CC	12/-	EY86	5/9	TY86F	11/10	BCY38	5/-
1T4	2/6	12AD6	9/-	E180CC	8/-	EY87	5/9	U12/14	7/6	BCY39	5/-
1U4	5/6	12AE6	7/6	E180F	17/6	EY88	7/6	U16	15/-	BFY50	5/-
1U5	5/3	12AT6	4/6	EA50	1/6	EY91	3/-	U18/20	6/6	BFY51	5/-
2D21	5/6	12AU6	4/9	EA76	13/-	EZ40	6/-	U19	40/-	BFY52	5/-
2X2	3/-	12AV6	5/9	EABC80	5/9	EZ41	6/6	U22	5/9	BFZ12	7/6
3A4	3/6	12BA6	5/-	EAC91	3/3	EZ80	3/9	U25	11/-	BY100	3/6
3A5	8/-	12BE6	5/3	EAF42	7/6	EZ81	4/3	U26	8/6	BYZ13	7/6
3B7	5/-	12BH7	6/-	EB41	4/9	FC4	12/6	U31	6/3	CG12E	4/-
3D6	3/9	12E1	17/6	EB91	2/3	GZ33	12/6	U33	13/6	GET103	4/6
3Q4	5/3	12J7GT	6/6	EBC33	6/-	GZ34	10/-	U35	16/6	GET113	5/-
3Q5GT	6/6	12K5	8/-	EBC41	7/3	GZ37	14/6	U37	34/11	GET116	12/-
3S4	4/9	12K7GT	3/6	EBC81	6/3	HABC80	9/3	U45	15/6	GET118	7/6
5R4GY	8/9	12K8GT	7/9	EBF80	5/9	HL41DD		U76	4/6	GET119	7/6
5U4G	4/9	12Q7GT	3/6	EBF83	7/-		19/6	U191	10/-	GET573	12/6
5V4G	8/-	12SA7GT	8/9	EBF89	5/9	HL42DD	8/-	U281	8/9	GET587	12/6
5Y3GT	5/-	12SC7	4/-	EBL21	10/3	HN309	26/6	U282	12/3	GET887	7/6
5Z3	7/6	12SK7	3/-	EC52	4/3	HVR2	8/9	U301	12/6	GET889	7/6
5Z4G	7/6	12SQ7GT	8/-	EC54	6/-	HVR2A	8/9	U329	9/-	GET890	7/6
6A8G	7/6	14H7	9/6	EC86	11/6	KT33C	19/6	U403	6/6	GET896	7/6
6AG5	2/6	14S7	19/6	EC88	10/6	KT36	29/1	U404	6/-	GET897	7/6
6AG7	5/9	19AQ5	5/-	EC91	4/-	KT41	19/6	U801	18/-	GET898	7/6
6AK5	4/9	20D1	10/-	EC92	6/6	KT44	5/9	U4020	6/-	MAT100	7/9
6AM4	16/6	20D4	20/5	ECC31	15/6	KT61	12/-	UABC80	5/3	MAT101	8/6
6AQ5	4/9	20F2	11/8	ECC32	4/6	KT63	4/-	UAF42	7/9	MAT120	7/9
6AT6	3/9	20L1	13/-	ECC33	29/1	KT66	16/6	UB41	10/6	MAT121	8/6
6AU6	5/6	20P1	17/6	ECC34	29/6	KT88	27/6	UBC41	6/6	OA5	5/6
6AV6	5/-	20P3	15/-	ECC35	4/9	KTW61	4/3	UBC81	6/6	OA10	6/6
6B8G	2/6	20P4	18/-	ECC40	9/6	KTW62	12/6	UBF80	5/6	OA70	3/-
6BA6	4/6	20P5	18/-	ECC81	3/6	KTW63	4/-	UBF89	5/9	OA73	3/-
6BE6	4/3	25A6G	7/6	ECC82	4/6	MHLD6	12/6	UBL21	9/-	OA79	3/-
6BH6	6/6	25L6	4/9	ECC83	4/6	MU14	4/-	UC92	5/6	OA81	2/-
6BJ6	7/-	25Y5G	8/6	ECC84	5/6	N37	23/3	UCC84	8/-	OA85	3/-
6BQ7A	7/-	25Z4G	6/3	ECC85	5/-	N78	38/4	UCC85	6/6	OA86	4/-
6BR7	9/-	25Z6	8/6	ECC88	7/-	N108	26/7	UCF80	8/3	OA90	3/-
6BR8	8/-	30C15	10/6	ECC189	9/-	N339	25/-	UCH21	9/-	OA91	3/-
6BS7	16/6	30C17	11/6	ECC807	19/9	PABC80	7/6	UCH42	8/6	OA95	2/-
6BW6	7/-	30C18	9/6	ECF80	7/-	PC86	8/6	UCH81	6/-	OA182	3/-
6BW7	5/-	30F5	9/9	ECF82	6/9	PC88	8/6	UCL82	7/-	OA200	3/-
6BZ6	6/-	30FL1	13/-	ECF86	8/6	PC95	6/9	UCL83	8/9	OA202	2/-
6C9	10/9	30FL12	13/-	ECF804	24/-	PC97	5/9	UF41	7/9	OA210	9/6
6CD6G	19/6	30FL13	6/-	ECH21	9/6	PC900	8/-	UF42	4/9	OA211	13/6
6CH6	6/-	30FL14	11/-	ECH35	6/-	PCC84	5/6	UF80	6/9	OAZ200	12/-
6CW4	13/-	30L15	13/-	ECH42	8/9	PCC85	5/9	UF85	7/3	OAZ202	9/-
6D3	7/6	30L17	12/-	ECH81	5/-	PCC88	10/6	UF86	9/-	OAZ203	9/6
6E5	9/6	30P4	11/6	ECH83	7/-	PCC89	9/9	UF89	5/6	OAZ204	9/-
6F1	9/6	30P4MR		ECH84	6/6	PCC189	8/3	UL41	8/9	OAZ210	7/-
6F6G	4/-		13/-	ECL80	6/-	PCF80	6/3	UL46	9/6	OC19	25/-
6F13	3/6	30P12	9/	ECL82	6/3	PCF82	6/-	UL84	5/6	OC22	5/-
6F18	7/6	30P19	10/-	ECL83	9/-	PCF84	8/-	UM80	5/-	OC23	7/-
6F23	8/-	30PL1	12/9	ECL84	12/-	PCF96	8/-	UR1C	6/6	OC25	7/-
6F24	10/-	30PL13	13/3	ECL85	11/-	PCF800	10/6	UU8	16/6	OC26	5/-
6F25	10/-	30PL14	13/3	ECL86	7/9	PCF801	8/6	UY1N	10/3	OC28	5/-
6J5G	3/9	30PL15	13/6	ECLL800		PCF802	9/6	UY21	9/-	OC29	16/6
6J6	3/-	35A5	15/-		23/9	PCF805	9/6	UY41	5/6	OC30	8/-
6J7G	4/9	35L6GT	6/3	EF9	20/6	PCF806	11/6	UY85	4/9	OC35	10/-
6K7G	1/3	35W4	4/6	EF22	6/6	PCF808	11/-	VM84B	12/6	OC36	10/-
6K8G	3/-	35Z3	10/-	EF36	3/-	PCL81	9/-	VP4	14/6	OC41	5/-
6K8GT	7/6	35Z4GT	4/6	EF37A	7/-	PCL82	6/3	VP13C	7/-	OC42	6/9
6K25	24/-	35Z5GT	5/6	EF39	5/-	PCL83	8/6	VR105	5/-	OC43	12/6
6L1	10/-	50B5	6/3	EF40	8/9	PCL84	7/-	VR150	5/-	OC44	8/-
6L6	7/6	50C5	5/9	EF41	9/-	PCL85	8/3	W76	3/6	OC44PM	8/3
6L7GTM	5/6	50CD6G	40/9	EF42	3/6	PCL86	8/-	W81M	6/-	OC45	2/6
6L18	7/6	50L6GT	6/-	EF50	2/6	PEN45	7/-	W107	10/6	OC45M	8/-
6L19	19/-	72	6/6	EF54	6/-	PEN45DD		W729	10/-	OC46	3/-
6LD20	6/6	80	5/3	EF73	5/-		19/6	X61	6/-	OC65	22/6
6N7GT	7/-	85A2	8/6	EF80	4/6	PEN383	9/6	X61met	12/-	OC66	25/-
6P1	12/-	90CG	24/-	EF83	9/9	PEN453DD		X65	5/6	OC70	3/-
6P28	25/-	90CV	33/6	EF85	4/6		19/6	X66	7/6	OC71	2/6
6Q7G	5/-	90C1	16/-	EF86	6/3	PENDD		X76M	7/9	OC72	2/6
6Q7GT	8/9	150B2	14/6	EF89	4/9	4020	17/6	X78	26/2	OC73	16/-
6B7G	5/6	807	11/9	EF91	3/3	PFL200	13/6	X79	40/9	OC74	8/-
6S7	7/9	5763	10/-	EF92	2/6	PL33	9/-	X81M	29/1	OC75	2/-
6SJ7GT	5/-	6060	6/-	EF97	8/-	PL36	9/-	Y63	5/-	OC76	3/-
6SK7GT	4/6	AC2PEN	DD	EF98	9/-	PL38	19/9	Z66	7/3	OC77	4/-
6SL7GT	4/9		19/6	EF183	6/3	PL81	6/9	TRANSISTORS & DIODES		OC78	3/-
6SN7GT	4/6	AC/VP2	11/-	EF184	5/9	PL82	5/9			OC81	2/3
6U4GT	9/6	AC/TH1	10/-	EF804	20/5	PL83	6/-			OC81D	2/3
6U8G	5/-	AZ1	8/-	EH90	7/6	PL84	6/3			OC81M	5/-
6V6G	3/6	AZ31	7/9	EK32	5/9	PL500	13/6			OC82	2/3
6V6GT	6/6	AZ41	6/6	EL32	3/-	PM84	9/3			OC83	3/-
6X4	3/6	B36	4/9	EL33	12/-	PX4	14/-			OC84	4/-
6X5GT	5/3	BL63	10/6	EL34	9/6	PY31	6/6			OC123	4/6
6Y6G	3/6	CY31	6/6	EL36	8/9	PY32	8/6			OC139	13/-
6/30L2	9/6	DAF91	3/3	EL41	8/-	PY33	8/6			OC140	19/-
7B6	10/9	DAF96	6/-	EL42	7/6	PY80	5/-			AD140	10/6	OC169	4/-
7B7	7/-	DD4	10/6	EL81	8/-	PY81	5/-			AD149	10/6	OC170	2/6
7C6	6/-	DF66	15/-	EL83	6/9	PY82	5/-			AF102	18/-	OC171	4/-
7D6	15/-	DF96	6/-	EL84	4/6	PY83	5/6			AF114	4/-	OC172	4/-
7H7	5/-	DF97	10/-	EL85	7/6	PY88	7/3			AF115	3/-	OC200	6/6
7R7	12/6	DH76	3/6	EL86	8/-	PY800	6/-			AF116	3/-	OC201	23/-
7Y4	6/6	DK40	10/6	EL91	2/6	PY801	6/-			AF117	4/-	OC202	28/-
7Z4	4/6	DK91	4/9	EL95	5/-	QQV03/10				AF118	3/-	OCP71	27/6
9BW6	9/6	DK92	7/6	ELL80	13/-		30/-			AF119	3/-	ORP12	15/-

All goods are new, first quality brands only, and subject to maker's full guarantee. We do not handle manufacturers' seconds nor rejects, which are often described as "new and tested" but have a limited and unreliable life.
Terms of business: Cash with order only. Post/packing 6d. per item. Orders over £5 post/packing free. All orders cleared on day of receipt. Any parcel insured against damage in transit for only 6d. extra. Callers welcome Mon.-Fri. 9-5 p.m. Sats. 9 a.m.-1 p.m. Complete catalogue of valves, transistors and components with conditions of sale, price 6d.



choice of professionals... practical for enthusiasts

EMI SPEAKERS...

The quality of sound reproduction is vitally important to E.M.I. — the largest recording organization in the world. E.M.I. Matched Speaker Sets reproduce every detail of the original sound over the full audio spectrum, at high or low listening levels. E.M.I. Speakers are examples of the most advanced audio engineering at a realistic cost. For their size and price they give unrivalled response. With many unique features and innovations they range from the Type 250 set with a 5" woofer and Hi Fi unit for enclosures of 11" x 8" x 6", to the Type 950 set for which an enclosure of 3½ to 4 cu. ft. is required.
The EMISOUND Audio Advice Bureau places all our experience of sound reproduction at your service. Send us your problems and fill in the coupon for details of E.M.I. Speakers.

EMISOUND

EMI SOUND PRODUCTS LTD
HAYES · MIDDLESEX
TEL: 01-573 3888

Please send me details of EMI MATCHED SPEAKER SETS

Name_____

Address_____

Tel. No._____

WW—127 FOR FURTHER DETAILS

WHY NOT BUILD ONE OF OUR PORTABLE TRANSISTOR RADIOS...

ROAMER SEVEN Mk. IV.

7 WAVEBAND PORTABLE OR CAR RADIO AMAZING PERFORMANCE AND SPECIFICATION

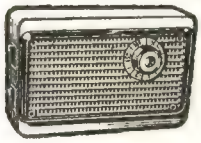
★ *USES PHILCO MICRO-ALLOY R.F. TRANSISTORS.*
★ **Fully tunable on all wavebands.**
★ **9 stages—7 transistors and 2 diodes.**

Covers M. and L. Waves, Trawler Band and three Short Waves to approx. 15 metres. Push-pull output for room-filling volume from rich toned 6in. × 4in. speaker. Air spaced ganged tuning condenser. Ferrite rod aerial for M. & L. Waves and 6 section telescopic aerial for S. Waves. Real leather look case with gilt trim and shoulder and hand straps. Size 9×7×4in. approx. The perfect portable and the ideal car radio.

★ **Extra band for easier tuning of LUXEMBOURG, etc.**

Total cost of all parts NOW ONLY £5.19.6 P. & P. 5/6.

Parts price list and easy build plans 3/-. (Free with kit.)



TRANSONA FIVE WITH 3in. SPEAKER !

★ **7 stages—5 transistors and 2 diodes.**

Covers M. and L. Waves (Extended M.W. band for easier tuning of Luxembourg etc.). Incorporating ferrite rod aerial, tuning condenser, volume control, and new type fine tone super dynamic 3in. speaker, attractive case. Size 6½×4¼×1½in. approx.

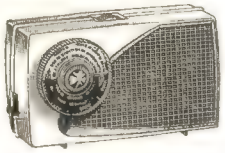
Total cost of all parts NOW ONLY 42/6 P. & P. 3/6.

Parts price list and easy build plans 2/-. (Free with kit.)

MELODY MAKER SIX

★ **8 stages. Six transistors and two diodes.** Covers Medium and Long Waves and Extra Band for EASIER tuning of LUXEMBOURG, etc. Top grade 3in. Loudspeaker for quality output. Two R.F. stages for extra boost. High 'Q' 6in. Ferrite Rod Aerial. Approx. 350 Milliwatts push-pull output. Handsome pocket size case with gilt fittings. Size 6½×3¾×1½. (Uses long-life PP6 battery). Carrying strap 1/6 extra. This amazing receiver may be built for only

£3 . 9 . 6 P. & P. 3/6.



Parts price list and easy build plans 2/-. (Free with kit.)

All components used in our receivers may be purchased separately if desired. Parts price lists and easy build plans available separately at prices stated. OVERSEAS POST 10/-.

RADIO EXCHANGE

61 HIGH ST., BEDFORD. 'Phone: 52367

Callers' side entrance Barretts Shoe Shop. *Weekdays 9-5 p.m.* *Sats. 9-12.30*

WW—128 FOR FURTHER DETAILS

WOW!!! SCOOP PURCHASE!

"VIDEO-TAPE RECORDERS"

(By Wesgrove)

Brand new in makers carton with full instructions, assembled, ready-to-go. Uses standard ¼in. triple play tape on 7" or 10½" spools. Giving 30 min. recording. Both Vision and Sound. (10½" spool included—But not tape.)

List 150 Gns. OUR PRICE ONLY 65 GNS.

plus 38/- Insurance and Packing

DEFINITELY UNREPEATABLE

Note: As this is a Special Offer a guarantee cannot be given, or an after sales service.

10 STATION EXECUTIVE "INTERCOMS"

Master and 10 Sub-stations, complete system, only **25 GNS.** (Elsewhere at least £90)

5 STATION VERSION! ONLY **15 GNS.**

Genuine offer—No catch!!! All brand new and guaranteed. Perfect for works, offices, hotels, etc.

Note: These units have been supplied with great success to Government Depts. and major combines.

Just arrived!!! **"Jet set aircraft band"** 10 transistor portable. Conversations, aircraft/control towers—clear as a bell. Incorporates also M.W. Gets all the Pirates. A real Fab' set at only 13½gns. + 8/6 P. & I.

HORNTONS, 15 Navigation St., Birmingham 2. *Tel: Midland 0972*

AVO STOCKISTS

MULTIMINOR MK. IV

MODEL 8 MK. III

REPAIR SERVICE 7-14 DAYS

We specialise in repair, calibration and conversion of all types of instruments, industrial and precision grade to BSS.89.

Release notes and certificates of accuracy on request.

Suppliers of Elliott, Cambridge and Pye instruments

LEDON INSTRUMENTS LTD

76-78 DEPTFORD HIGH STREET, LONDON, S.E.8

Tel.: TIDeway 2689

E.I.D. & G.P.O. APPROVED **CONTRACTOR TO H.M. GOVT**

TECHNICAL TRAINING by ICS IN RADIO, TELEVISION AND ELECTRONIC ENGINEERING

First-class opportunities in Radio and Electronics await the ICS trained man. Let ICS train YOU for a well-paid post in this expanding field.

ICS courses offer the keen, ambitious man the opportunity to acquire, quickly and easily, the specialized training so essential to success. Diploma courses in Radio/TV Engineering and Servicing, Electronics, Computers, etc. Expert coaching for:

* **INSTITUTION OF ELECTRONIC AND RADIO ENGINEERS.**
* **C. & G. TELECOMMUNICATION TECHNICIANS CERTS.**
* **C. & G. SUPPLEMENTARY STUDIES.**
* **R.T.E.B. RADIO AND TV SERVICING CERTIFICATE.**
* **RADIO AMATEURS EXAMINATION.**
* **P.M.G. CERTIFICATES IN RADIOTELEGRAPHY.**

Examination Students Coached until Successful.

NEW SELF-BUILD RADIO COURSES

Build your own 5-valve receiver, transistor portable, signal generator and multi-test meter—**all under expert tuition.**

POST THIS COUPON TODAY and find out how ICS can help YOU in your career. Full details of ICS courses in Radio, Television and Electronics will be sent to you by return mail.

MEMBER OF THE ASSOCIATION OF BRITISH CORRESPONDENCE COLLEGES.

INTERNATIONAL CORRESPONDENCE SCHOOLS

A WHOLE WORLD OF KNOWLEDGE AWAITS YOU!

International Correspondence Schools
(Dept. 222), Intertext House, Parkgate Road
London, S.W.11.

NAME .....

ADDRESS .....
Block Capitals Please

..... 8.67

RECEPTION SETS R220/R220
These comprise two crystal controlled AM receivers and can be operated independent of each other on one spot frequency in the band 60-100 Mc/s., with built in monitor speaker. They are housed in one metal cabinet, size 21¼ × 12⅝ × 18½in. and ready for immediate mains operation (200-250 v. 50 c/s.). Supplied BRAND NEW in original crate, complete with spares and manual. **£20.** Carr. 50/-.

FILTER VARIABLE BAND PASS No. 1
Dual channel unit. each channel has variable slot frequency of 500-900 c/s, 1,200-1,600 c/s., and band pass facility. 600 ohms input and output, monitor input and high impedance output jacks. Standard rack mounting 3½in. deep panel. Mains operation 200/250 v. 50 c/s. BRAND NEW. **£5/19/6.** Carr. 10/-.

MN26Y RADIO COMPASS RECEIVER
150-695 Kc/s. 3.4-7 Mc/s. 28 volt D.C. Input. Very good condition, **£4/19/6.** Carr. 10/6.

HRO TUNING METER. 0-1 ma. New and boxed **25/-.** Post 2/-.

RADIATION METERS
Portable dose rate meter containing modern type rectangular 50 micro-amp meter CVX 494, electrometer valves, etc. BRAND NEW. In canvas carrying case **£3/19/6.** Postage paid.

V.H.F. SIGNAL GENERATOR
MARCONI TF-810A. Covers 10 to 300 Mc/s. (4 bands). DIRECTLY calibrated. Int. Mod. at 400, 1,000 and 5,000 c/s. Attenuated or force output. Guaranteed overhauled, accurate and in perfect working order. **£32/10/-.** Carr. £1.

BEAT FREQUENCY OSCILLATORS
MARCONI TF-195M. Covers 10 cps. to 40 kc/s. in two sweeps. 0 to 20 kc/s. and 20 to 40 kc/s. Output 2 watts into 600 or 2,500 ohms. Panel meter indicates output voltage. A.C. mains operation 100 to 250 volts. First class condition.Fully tested. **£20.** Carr. 30/-.

AMERICAN HEADSET TYPE HS-30-U
600 impedance. BRAND NEW and boxed, **15/-,** postage 2/6.

MARCONI "Q" METER. Type 329G. As new condition and in perfect working order. **£65.** Carr. 50/-.

BC-221 FREQUENCY METERS
As new condition complete with crystal and valves. In perfect working order but **WITHOUT** calibration charts. **£9/19/6.** Carr. 10/6.

MICROAMMETERS
R.C.A. 0-500 microamps. 2½in. circular flush panel mounting. Dials are engraved 0-15, 0-600 volts. As used in the American version of the No. 19 set. BRAND NEW and boxed **15/-.** P. & P. 1/6.

AR-88 SPARES

Knobs, Medium size, Set of 8....	10/-
Knobs, Large size	5/6
Condenser (3 × 4 mfd.). Post 4/6.	12/6
Mains Trans. (L.F.) (postage 9/-)	42/6

MINIATURE RELAYS
240 v. A.C. coils. Contact assembly 2 "makes" and 1 C.O. 5 amps. Size 2 × 1½ × 1in. Unused and removed from brand new equipment **8/6** post paid.

LABORATORY pH METER

MARCONI type TF.1093/1. Range 0-14 pH. direct reading. Full temperature compensation. Scale expansion providing discrimination of 0.01 pH. A.C. mains operation. BRAND NEW complete with electrode stand and manual. Full details on request. **£35.**

CINTEL NUCLEONIC SCALERS
Nos. 36402 and 36411. Unused with handbook. List Price £300/£320. Our Price **£65.**

ATM RTTY AUDIO TERMINAL UNIT TYPE API00386F/SY. 1.1.
Less Carpenter Relay and hash filter chokes. Used condition **£4.19.6.** Carr. 10/-.

CRT Type 89D as used in the Cossor 1035 Oscilloscope. Brand New **59/6.** P. & P. 4/6.

ADVANCE TEST EQUIPMENT

H1B Audio Signal Generator	**£30 0**
J1B Audio Signal Generator	**£30 0**
J2B Audio Signal Generator	**£35 0**
TT1S Transistor Tester	**£37 10**
VM76 AC/DC Valve Voltmeter	**£72 0**
VM77C AC Millivoltmeter	**£40 0**
VM78 AC Millivoltmeter (transistorised)	**£55 0**
VM79 UHF Millivoltmeter (transistorised) ...	**£125 0**

These are current production, manufactured in U.K. by Advance Electronics Ltd. (not discontinued models). Showing a saving of approximately 33⅓% on nett trade price. BRAND NEW, all in original sealed carton. Carr. 10/- extra per item. Special offer of 10% discount for schools and technical colleges, etc.

OSCILLOSCOPE TYPE 13A

Double beam. Time base 2 c/s. to 750 kc/s. Band width up to 5 Mc/s. Calibration markers at 100 kc/s. and 1 Mc/s. Cathode follower probe for H.F. testing. Operates from A.C. mains 100 to 250 volts. A completely reliable quality instrument. Supplied fully checked with all leads, graticule, visor, circuit etc. **£22/10/-.** Carr. 30/-.

AVO CT38 ELECTRONIC MULTIMETER

95 range Valve Voltmeter incorporating 14 D.C. and 14 A.C. current ranges from 10μA f.s.d. to 25A f.s.d. Voltage ranges from 250 mV f.s.d. to 10,000V f.s.d. for both D.C., A.C. and low radio frequencies. Radio frequencies up to the order of 250 Mc/s. are covered with diode head used externally. The input resistance on D.C. volts is 10MΩ or 100MΩ dependent on the range in use. Four resistance ranges cover from 0.2Ω to 1000MΩ, whilst 30 wattage ranges give readings from 50μW f.s.d. to 5W f.s.d. Supplied in perfect condition with all accessories. **£22/10/-.** Carr. 15/-.

HRO MODEL 5T £30

The octal valve version. In mint condition. Complete with all nine general coverage coil sets covering 50 kc/s. to 30 Mc/s. instruction booklet and circuit, but less external power supply. Carriage 30/-. Complete manual available at 30/- extra.

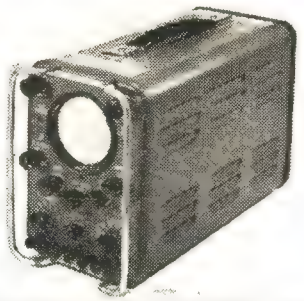
PRICES NOW REDUCED CINTEL EQUIPMENT.
ELECTROLYTIC CAPACITANCE AND INCREMENTAL INDUCTANCE BRIDGE No. 36601
A modern instrument, all solid state, which accurately measures the capacity of electrolytic condensers from 0.1μF to 1,000μF under operating conditions. Leakage current and polarizing voltage are separately metered. Inductances from 100 mH to 100 H can also be measured with current up to 100 mA. A.C. mains operation. Unused with handbook. List Price £220. Our Price **£70.**
WIDE RANGE CAPACITANCE BRIDGE. No. 1864.
A matching instrument to the above. All solid state. Mains operation. Measures from 0.002pF to 100μF. Unused with handbook. List Price £250. Our Price **£75.**

PULSE GENERATOR. MARCONI TYPE TF.675 F.
Repetition frequency 50 c/s. to 50 kc/s. Pulse duration 0.15 to 100μ sec. Variable amplitude positive or negative pulses of up to at least 30 volts peak across a load of 1kΩ or 50 volts across 100kΩ. Internal 0.1 and 0.5μ sec. delay lines. BRAND NEW complete with Manual. List Price £125. **Our price £45.**
WIDE-BAND MILLIVOLTMETER MARCONI TYPE TF.1371
100μv to 300 mv in five ranges. 30 c/s. to 30 mc/s. Further details on request. BRAND NEW, **£45.**
VACUUM TUBE VOLTMETER MARCONI TYPE TF.1300
A.C. measurement 0.05 to 100 v., 20 c/s. to 300 Mc/s. D.C. measurement 0.1 to 300 v. Each over 5 ranges. Will also measure ohms, 50Ω to 5mΩ in 2 ranges. Further details on request. BRAND NEW, **£45.**
DELAY GENERATOR MARCONI TYPE TF.1415.
Provides sweep-delaying facilities when used in conjunction with the TF. 1330 (series) or similar oscilloscope. Alternatively, it may be used independently as a general purpose delay generator. Detailed technical specification supplied upon request. **BRAND NEW. £35.**

SENSITIVE VALVE VOLTMETER MARCONI TYPE TF.1100
100μv to 300 v. A.C. in 12 ranges. 10 c/s. to 10 Mc/s. Can also be used as a w de-band amplifier. Further details on request. BRAND NEW. List Price £125. Our Price **£50.**

CHARLES BRITAIN (Radio) LTD.

11 UPPER SAINT MARTIN'S LANE
LONDON, W.C.2. *TEMple Bar 0545*
Near Leicester Sq. Station. (Opposite Thorn House)
Shop hours 9-6 p.m. (9-1 Thursdays). Open all day Saturday.



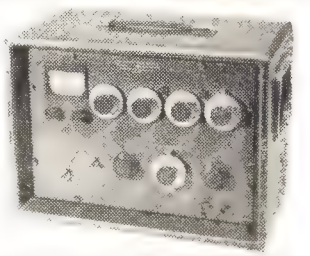
PORTABLE OSCILLOSCOPE CT.52.
A compact general purpose instrument with many unusual features. Size 9in. high, 8in, wide, 6½in. deep. Time base 10 c/s. to 40 kc/s. Y plate sensitivity 40 v. per cm. Tube 2½in. Frequency compensated amplifier up to 38 dB gain. Bandwidth up to 1 Mc/s. Single sweep facilities. Operates from A.C. mains 100-250 volts, 50 c/s. Complete with all test leads, metal transit case, instruction book and circuit diagram. BRAND NEW. Tested and guaranteed. **£22/10/-.** Carr. 10/-.

SIGNAL GENERATOR CT-218 (FM/AM). MARCONI TF 937.
Covers 85 Kc/s. to 30 Mc/s. in 8 switched ranges. Effective length of film scale is 50ft. Output level variable in 1 dB steps from 1μV to 100 mV (75Ω). Also IV Outputs down to 0.1 μV from an outlet at 7.5Ω. Int. mod. at 400 c/s., 1 Kc/s., 1.6 Kc/s. and 3 Kc/s. FM at frequencies above 394 Kc/s. Variable mod. depth and deviation. Crystal calibrator 200 Kc/s and 2 Mc/s. Monitor speaker for beat detection. Fully metered, blower cooled, Panclimatic. A.C. mains 100 to 150 and 200 to 250 volts, 45 to 100 c/s. 17 × 20½ × 17½in. Weight 117 lbs. Fully tested and guaranteed. Fraction of original cost. **£65.** Carr. 50/-.

T.C.C. METALPACK CONDENSERS. 0.1 mfd. 500 v. D.C. wkg. at 70°C. Brand new. polythene wrapped, **7/6** doz., or **£2** per 100. **T.C.C. METALMITE** 350 v. D.C. wkg. 0.1 mfd. (CP37N); 0.05 mfd. (CP35N); 0.91 mfd. (CP.32N) all at **5/6** doz. or **32/6** per 100. **SPRAGUE METAL CASED CONDENSERS** 0.01 mfd. 1,000 v. D.C. wkg., **5/6** doz., or **32/6** per 100.

T.C.C. VISCONAL CONDENSERS. 8 mfd. 800 v. D.C. wkg. at 71°C. CP 152 v. Size 3 × 1¾ × 5in. high. BRAND NEW (boxed), **8/6** each. **DUBILIER.** 4 mfd. 600 v. wkg. CP 130T or similar. 1¾ × 1¾ × 4¾in. high. BRAND NEW boxed), **4/6** each. All post paid.

STANDARD TRANSFORMERS
Vacuum impregnated, interleaved, E.S. screen, universal mounting. Size 4×3½×2½in. ALL BRAND NEW. **24/-** each. Post 4/6.
Type 1. 250-0-250 v. 80 mA. 6.3 v. 3.5 a., 6.3 v. 1 a., tapped at 2 a.
Type 2. As above but 350-0-350 v. 80 mA.
Type 3. 30 v. 2 a., tapped at 12, 15, 20 and 24 v. to give 3-4-5-6-8-9-10 v., etc.
Type 5. 0-6-9-15 v. 4 a. Ideal for chargers.



LOW CAPACITANCE BRIDGE
MARCONI TF. 1342. Range 0.002 pF. to 1,111 pF. Accuracy 0.2%. Three terminal transformer ratio arm bridge allows "in situ" measurements. Internal oscillator frequency 1,000 c/s. 12 × 17 × 8½in. Weight 15¾ lbs. A.C. mains 200 to 250 and 100 to 150 v. 40-100 c/s. With leads and handbook. **ABSOLUTELY BRAND NEW.** List Price £120. Our Price **£45.**

IMMEDIATE DESPATCH FULL SPARES AND SERVICE AVAILABLE

20 Amp. LT. SUPPLY UNIT

As supplied to Min. of Defence and Crown Agents for overseas Govts.

LATEST DESIGN HEAVY DUTY 12/24 VOLT D.C.

Output: Adjustable up to **20 AMPS. CONTINUOUS** at 12/24 volts. **FULLY FUSED,** Neon indicator, 0-20 amp meter. Size 16 x 12 x 20in. high, in heavy gauge steel cabinet. Grey Hammer finish—Weight:50lbs. Input: 220/230/240 v. A.C. 50 cycles.

ONLY £32.10.0 Plus 40/- C. & P. G.B. (Inland)

BUY DIRECT FROM MANUFACTURER. CURRENT PRODUCTION

30 Amp. LT. SUPPLY UNIT

UP TO 18v. D.C. WITH SMOOTH STEPLESS VARIATION

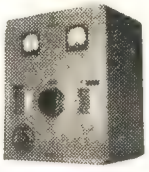
Designed for CONTINUOUS use at max. loading

★ Fitted voltmeter and ammeter ★ Instantaneous overload cut-out. Input: Mains A.C., robust construction, 2 tone finish, steel case.

£55.0.0 C. & P. 40/-. G.B. (inland).

Entirely suitable for plating plants, Laboratory supplies etc.

5 AMP. A.C. & D.C. VARIABLE SUPPLY UNIT



Specification: Output: 0-260 v. A.C. 0-240 v. D.C.

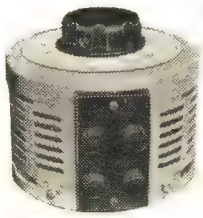
★ **Smooth stepless voltage variation from 0-Max.**
★ **Current consistent throughout the controlled range.**
★ **Ammeter and voltmeter, fitted and neon indicator.**
★ **Fully fused input and output.**

Strong steel case, with carrying handle and rubber feet. 11 x 7 x 14in. high. Made in England.

£30.0.0 C. & P. 40/-. Gt. Britain (inland).

CURRENT PRODUCTION—BUY DIRECT FROM MANUFACTURER

VARIABLE VOLTAGE TRANSFORMERS



Modern styling for modern equipment

'SLIDE-TRANS' & 'SLIDUP' MODELS

Fully rated current consistent at all points along the winding

AVAILABLE ONLY FROM I.M.O.

★ SMOOTH CONTINUOUS ADJUSTMENT
★ ALL MODELS SHROUDED FOR SAFETY
★ IDEAL FOR EDUCATIONAL AUTHORITIES
★ BENCH OR PANEL MOUNTING
★ UP TO 260v. AVAILABLE FROM ALL MODELS

All models 230v. A.C. 50/60 c.p.s.

1 Amp.	£4 . 10 . 0
2.5 Amp.	£5 . 17 . 6
5 Amp.	£9 . 0 . 0
8 Amp.	£13 . 10 . 0
10 Amp.	£18 . 5 . 0
12 Amp.	£19 . 10 . 0
20 Amp.	£32 . 10 . 0

C. & P. EXTRA

TRANSISTORISED MEGOHMMETER

★ **PUSH BUTTON TO READ**

500 v. - 1,000 Megohms. Superb portable instrument. Supplied c/w batteries, probes and carrying case.

ONLY **£25.0.0** C. & P. 7/6.

VARIABLE HIGH VOLTAGE SAMPLING TESTER

DIELECTRIC BREAKDOWN TESTER

★ **Range:** Infinitely variable up to 3,000 volts 0.1 amp.
★ Entirely suitable for continuous testing.
★ Automatic safety cut-out. **Input:** Mains voltage. Input and test leads with clips.

Model T30
C. & P. 25/-. **£15**

CONSTANT VOLTAGE TRANSFORMERS

AUTOMATIC MAINS STABILISER

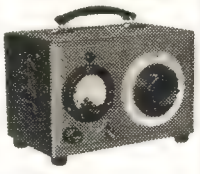
Maintain consistently accurate test gear readings.

★ **No Moving parts.**
★ **Corrected Wave.**

Input 190-270 v. A.C.
Output: 240 v. A.C.
Accuracy: ± 1 per cent.
Capacity: 250 watts.
Fitted signal lamp and switch.

C. & P. 20/-. **£12.10.0**

PORTABLE VARIABLE A.C. POWER SUPPLY UNIT



Designed for engineers whose requirements call for a visual indication of volts applied.

OUTPUT:
0-260 v. 1½ amps.
INPUT:
230 v. A.C. 50/60 c.p.s.
Fitted with fuse, voltmeter, safety indicator on-off switch and lead. Size 8 x 5 x 5in. high.

PRICE £8.17.6 C. & P. 12/6

PORTABLE TRANSISTOR TESTER

SUITABLE FOR PRODUCTION & LABORATORY USE

SPECIFICATION.
Alpha 0.7 to 0.997
Beta 5-300.
ICO 0-50uA. 5 mA.
Capable of measuring GERMANIUM AND SILICON DIODES. DESIGNED WITH RESISTANCE SCALE 200 ohms to 1 Megohm as an ADDED FEATURE. Housed in heavy duty plastic case, c/w internal battery and leads.

Only
£7.15.0
Plus 7/6 C.& P.

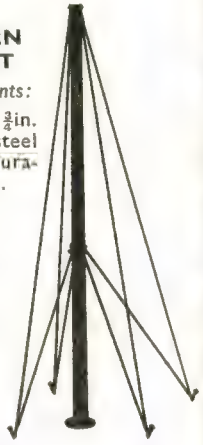
36ft AERIAL MASTS

NEW!

LATEST PATTERN TUBULAR MAST

Check these vital points:

★ Made from 6ft.x1¾in. dia. Sheradized steel sections, for durability and strength.
★ Extra strong locating base.
★ Top cap with fitted pulley and halyard
★ 2 sets (8) rot-proof guys
★ Rustproofed steel picketing stakes.



ONLY
£15.0.0 EX. WORKS
Carriage 20/-
Returnable wood case 30/-

I · M · O (ELECTRONICS) LTD. **(Dept. W.W.7), 313 Edgware Road, London, W.2.** *PADdington 2233/4*

Wilkinsons FOR RELAYS

P.O. TYPE 3000 AND 600

BUILT TO YOUR REQUIREMENTS—QUICK DELIVERY
COMPETITIVE PRICES—VARIOUS CONTACTS
DUST COVERS—QUOTATION BY RETURN

LARGE STOCKS HELD OF MINIATURE SEALED RELAYS INCLUDING HIGH SPEED
G.E.C. — SIEMENS — S.T.C — ERICSSON — E.M.I. — BEST MAKES
25,000 IN STOCK—150 TYPES—DETAILED LIST ON REQUEST

MINIATURE SILVER ZINC ACCUMULATOR. 1.5 volt, 1.5 ampere. Size 2in. × 1.13in. × 0.63in. Weight 1½ oz. Ideal for model work, **12/6** ea. **120/-** doz., post 9d.
STROBOSCOPE FORK. 125 cycles. P.O. No. 5, **30/-** ea., post 2/-.

GEARED MOTORS. For window displays 3 RPM or 1 RPM, 24 v. A.C., 4 watts, reversible, **35/-.** Post 2/6.
TRANSFORMER to operate the above from 230/240 v. A.C.. **20/-.** Post 4/6.

TRANSISTOR BARGAINS. On printed circuit boards with diodes, miniature resistors and condensers.
No. 1 (2) OC23, (2) OA5, (18) SX641 (Value 85/-) **17/6**
No. 2 (3) GET872, (3) GET872B, (3) SX641, (9) OA5, (3) CV448. (Value 79/6) **17/6**
No. 3 (5) GET 104, (5) GET 872, (10) OA5 (Value 100/-) **22/6**
No. 4 (3) TK25, (4) GET872 (Value 39/-) **12/6**
No. 5 (9) ASY60, (6) SX641, (3) TK25, (12) OA5, (Value 125/-) **22/6**
No. 6 (64) OA5 (Value 192/-) **30/-**

SUB-MINIATURE LAMPS. Flying leads, 0.75v., **50/-**100.
ELCOM STUD SWITCHES. 12 pole 2 way or 3 way types on 3 Banks, break before make action, **50/-.**
HAIR HYGROMETERS, 4in. round Negretti & Zambra, scaled 0/100 reading relative percentage humidity, **65/-,** post 3/-.

AUTO TRANSFORMERS by S.T.C. Totally enclosed C-core type. 110/250 volts. 8 tappings. 50 cycles. 1,000 watts. Size 6½ × 5½ × 5½in., **£4.** Post 10/6.

ONE HOLE FIXING SWITCHES
SINGLE POLE Double Throw, 3 amp. 250 v. A.C., can be used as ON/OFF or CHANGE-OVER switch.
12/- per dozen, 85/- per 100
post 2/- post 5/-

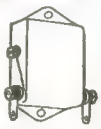
VEEDER-ROOT MAGNETIC COUNTERS WITH ZERO RESET 800 COUNTS PER MINUTE, COUNTING TO 999,999. 230 volts A.C. or 110 v. D.C., **65/-.** Post 3/-.
JACK PLUGS. 2 Point, with screw-on cover, **2/6,** post 9d. P.O. 201 with cord, **3/-,** post 1/6; P.O. 316, 3 Point, **5/6,** post 9d.

POTENTIOMETERS, RESISTORS, WIREWOUND AND CARBON. Quantities ex-Stock. Low prices.
MAINS TRANSFORMERS. Output 300-0-300 volts, 250 mA, 6.3 volts, 9 amps, **25/-.** Post 6/-.

STABILIZED POWER UNITS RACAL Inst. type PU 156C, A.C. input 200/250 v D.C. Output positive HT 200/300 v stabilized. Load current 250 ma negative HT 150 v. stabilized 15 ma. NEW

METERS GUARANTEED. Complete list available

Microamps 0/100 2½in. MC **40/-**
Microamps 0/500 2in. MC **25/-**
Microamps 0/500 2½in. MC **37/6**
Milliamps 0/50 2½in. MC **35/-**
Milliamps 0/500 3½in. MC **54/-**
Amps 0/5 2in. MC..... **27/6**
Volts 5-0 5 2½in. MC.... **25/-**
Volts 0/40 2in. MC..... **42/6**
Volts 0/5 A.C. 3½in. MC.. **55/-**
Volts 0/10 AC 3½in. MCR **70/-**
Microamps 0/50 scaled in Milli Rontgens 2½in. MC **45/-**
Millivolts 350/0/350 (3.5/0/3.5) MilliA) 2½in. MC **35/-**
UNISELECTOR DIGIT SWITCHES 8 level 12 outlets 3 bridging 5 non-bridging 50 volts. NEW **£8/10/- each.**
MINIATURE BUZZERS (as illus.), 12 volt with tone adjuster, **7/6.**



EQUIPMENT RACKS, 5ft. high, **£5** and **POST OFFICE STANDARD** 6ft. high with U-channel sides drilled for 19in. panels, heavy angle base, **£7/10/-** cge. 20/-. 10ft. 6in. high, **£12** cge. 25/-.
SOLDER. Multicore 5-core 182ft. 60/40. 18 s.w.g. 1lb. reel, **12/6.** Post 2/6.

L. WILKINSON (CROYDON) LTD.
LONGLEY HOUSE LONGLEY RD. CROYDON SURREY
Phone: THO 0236 Grams: WILCO CROYDON

NO EXCUSES! NO DELAYS! FROM STOCK!

VARIABLE VOLTAGE TRANSFORMERS

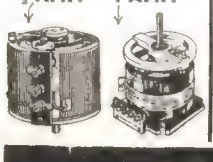
PORTABLE

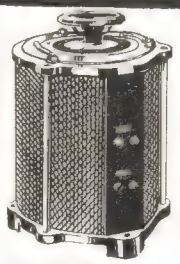
Input 230 v. A.C. Output variable 0-260 v. A.C. at 1.5 amp. Fitted in beautifully finished steel case. Complete with voltmeter, pilot lamp, fuse, switch, carrying handle.
£8/10/-. P. & C. 10/-.
Also 2.5 amp. as above, **£9/17/6.** P. & C. 10/-.

OPEN TYPES

Designed for Panel Mounting
Input 230 v. A.C. 50/60
Output variable.
0-260 v.
½ amp. .. **£3 3 0**
1 amp. **£4 10 0**
2½ amp. **£5 12 6**

½ AMP. **1 AMP.**





50 AMPS

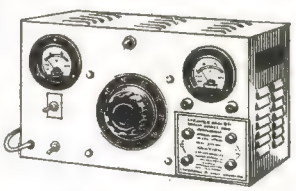
1 AMP.

INPUT 230 v. A.C. 50/60
BRAND NEW. Carriage Paid. Buy direct from the importer, keenest prices in the country. All Types (and Spares) from ½ to 50 amp. available from stock.

0–260 v. at 1 amp.	£4 10 0
0–260 v. at 2.5 amps.	£5 17 6
0–260 v. at 5 amps.	£9 0 0
0–260 v. at 8 amps.	£13 10 0
0–260 v. at 10 amps.	£17 0 0
0–260 v. at 12 amps.	£19 10 0
0–260 v. at 15 amps.	£22 0 0
0–260 v. at 20 amps.	£32 10 0
0–260 v. at 37.5 amps.	£65 0 0
0–260 v. at 50 amps.	£85 0 0

16 DIFFERENT TYPES AVAILABLE FOR IMMEDIATE DELIVERY.

5 Amp. AC/DC VARIABLE VOLTAGE OUTPUT UNIT



Input 230 v. A.C. Output 0-260 v. A.C. Output 0-240 v. D.C. Fitted large scale ammeter and voltmeter. Neon indicator, fully fused. Strong attractive metal case 15in. x 8¾in. x 6in. Weight 24 lb. Infinitely variable, smooth stepless voltage variation over range.
Price **£30** C. & P. £2.

7 Amp. A.C./D.C. Mk. II Variable Output Power Unit
Input 230 v. A.C. Output continuously VARIABLE from 0 to 260 v. A.C. OR 0 to 230 v. D.C. at 7 a. Robustly constructed in metal case, complete with safety fuse, neon indicator, voltmeter and ammeter. Size 17in. x 12in. x 7in. Weight 36 lb. Price **£39/10/-.** Carriage 40/-.

CONSTANT VOLTAGE TRANSFORMERS

Input 185-250 v. A.C. Output constant at 230 v. A.C. Capacity 250watt. Attractive metal case. Fitted red signal lamp. Rubber feet. Weight 17lbs. Price **£11/10/-.** P. & P. 10/-.

Double Wound Variable Transformers

Fully isolated, low tension Secondary winding. Input 230 v. A.C. OUTPUT CONTINUOUSLY VARIABLE 0-36 v. A.C.
0-36 v. at 5 amp. £8.10.0—p. & p. 8/6
0-36 v. at 20 amp. £19.10.0—15/- c. & p.
These fully shrouded Transformers designed to our specifications, are ideally suited for Educational, Industrial and Laboratory use.

36 volt 30 amp. A.C. or D.C. Variable L.T. Supply Unit

INPUT 220/240 v. A.C.
OUTPUT CONTINUOUSLY VARIABLE 0-36v
Fully isolated. Fitted in robust metal case with Voltmeter, Ammeter, Panel Indicator and chrome handles. Input and Output fully fused. Ideally suited for Lab. or Industrial use. £55 plus 40/- c. & p. Similar in appearance to above illustration.

SERVICE TRADING COMPANY

SERVICE TRADING CO

Postage and Carriage shown below are inland only. For Overseas please ask for quotation. We do not issue a catalogue or list.

LIGHT SENSITIVE SWITCHES

Kit and parts including ORP.12 Cadmium Sulphide Photocell. Relay Transistor and Circuit. Now supplied with new Siemens High Speed Relay for 6 or 12 volt operations. **Price 25/-, plus 2/6 P. & P.**
ORP.12 and Circuit 10/- post paid.

A.C. MAINS MODEL

Incorporates mains transformer rectifier and special relay with 3×5 amp. mains c/o contacts. Price inc. circuit **47/6**, plus 2/6 P. & P.

PHOTO ELECTRONIC COUNTER

Can be set for counts of up to 500 per minute. 210-250 v. A.C. powered. Kit of Components, including photo cell, high speed non-resettable counter, transformer, relay, etc., together with clear circuit diagram. **£3/2/6**, plus 3/6 P. & P. With re-settable counter, **£4/2/6**, P. & P. 3/6.

LIGHT SOURCE AND PHOTO CELL MOUNTING

Precision engineered light source with adjustable lens assembly and ventilated lamp housing to take MBC bulb. Separate photo cell mounting assembly for ORP.12 or similar cell with optic window. Both units are single hole fixing. Price per pair **£2/10/-**, plus 3/6 P. & P.

ULTRA VIOLET BULBS

Easy to use source of U.V. for dozens of practical and experimental uses.
12 volt 36 watt A.C./D.C. SBC, **6/6**. P. & P. 1/-.
12 volt 60 watt A.C./D.C. SBC, **8/6**. P. & P. 1/-.
Transformer to suit the above. Input 200-240 v. A.C. 12 volt 36 watt, **21/-**. P. & P. 2/6. Input 200-240 v. A.C. 12 volt 60 watt, **27/-**. P. & P. 3/6.
Set of 4 Colours FLUORESCENT PAINT. Red, yellow, green and cerise. In 1 oz. jars. Ideal for use with the above Ultra Violet Bulbs, **11/-** plus 2/6 P. & P.

SIEMENS SEALED HIGH SPEED RELAYS

H96A. 2.2 ohm+2.2 ohm, H96G, 50 ohm+50 ohm, H96C, 145 ohm+145 ohm, H96E, 1,700 ohm+1,700 ohm. All at **12/6** each. P. & P. 1/6 on each Relay. Bases 4/6 each.

P.O. RELAYS Type 3000

100 ohms 3 c/o, 2 make, 2 break. 200 ohms, 6 c/o. 500 ohm, 1 Heavy duty c/o. 500 ohm, 4 Heavy duty make. 16,000 ohm, 2 make, 2b reak. 20,000 ohm, 2 Heavy duty make. 2,000 ohm 2 c/o. All at **12/6** each. Plus 1/6 P. & P.

SOLENOID. Overall length 3¼in., stroke ¼in. to ½in. Maximum push 8 oz. 12-24 v. D.C. operation. D.C. resistance 35 ohm. Price **8/6**. P. & P. 1/6.

INSULATED TERMINALS

Available in black, red, white, yellow, blue and green. New **15/-** per doz. P. & P. 2/-.

COMPACT HEAVY DUTY 6 volt DC RELAY

6-9 volt D.C. operation 30 ohm coil 2×10 amp. c/o contacts, will handle up to 250 volt A.C. Size 1⅞in. high × 2¼in. × 1¼in. Price **7/6**, plus 1/6 P. & P. 3 for **20/-** post paid.

LATEST HIGH SPEED MAGNETIC COUNTERS

4 figure, 10 impulses per second. Type 100A, 500 ohm coil, 18-24 v. D.C. operation. Type 100B, 2,300 ohm coil, 36-48 v. D.C. operation. Any type, **15/-** each, plus 1/6 P. & P.

RESETTABLE HIGH SPEED COUNTER

4 figure, 1,000 ohm coil, 36-48 v. D.C. operation. **£3/10/-**. P. & P. 1/6.
3 figure, 700 ohm coil, 24v. D.C. **£2/2/-**. P. & P. 1/6.

SEMI-AUTOMATIC "BUG" SUPER SPEED MORSE KEY

7 adjustments, precision tooled, speed adjustable 10 w.p.m. to as high as desired. Weight 2½lb. **£4/12/6** post paid.
TRANSISTORISED MORSE OSCILLATOR Fitted 2½in. Moving Coil Speaker. Uses type PP3 or equiv. 9 v. battery. Complete with latest design Morse Key. **22/6**, plus 1/6 P. & P.

230 v. A.C. RELAY. 2 c/o 2 amp. contacts. **9/6**, ex new equip. P. & P. 1/6.

SLIDER RESISTANCE

200 ohm 1.25 amp., **37 6**. P. & P. 3/6.

Condenser 5,000 m/d 50 v. 1¾ × 4¼in. 12/6. New.

SPECIAL OFFER OF FIRST GRADE GUARANTEED TRANSISTORS. OC83—3 for **12/6**. OC81—4 for **10/-**. OC81D—4 for **10/-**. OC45—3 for **10/-**. OC44—3 for **10/-**. Post paid.

34R SILICON SOLAR CELL

4×.5 volt unit series connected, output up to 2 v. at 20 mA. in sunlight. 30 times the efficiency of selenium. As used in power Earth Satellites, **37/6**. P. & P. 1/-.

'SOLAR CELL AND PHOTO-CELL EXPERIMENTERS' GUIDE"

Teaches the principles of light sensitive devices and their application. **26/-** post paid.

230 VOLT A.C. GEARED MOTORS

Type D15G 5 r.p.m. 1.7lb. inch, £2/9/6. P. & P. 3/-
Type B16G 80 r.p.m., 26 lb. inch, £2/2/-. P. & P. 3/-.
Type D16G 13 r.p.m. 1.45lb. inch, £2/17/6. P. & P. 3/-.

VAN DE GRAAF ELECTROSTATIC GENERATOR,

fitted with motor drive for 230 v. A.C. giving a potential of approx. 50,000 volts. Supplied absolutely complete including accessories for carrying out a number of interesting experiments, and full instructions. This instrument is completely safe, and ideally suited for School demonstrations. Price **£6/6/-** plus 4/- P. & P. Lft. on req.

UNIVERSAL DEMONSTRATION TRANSFORMERS

Stenzyl Type

A complete composite apparatus, comprising a robustly built Transformer and electro-magnet with removable coils and pole pieces. Coil tapped for 230 v., 220 v., 110 v., 115 v., 6, 12, 36, 110 v. A.C. These coils are also used for D.C. experiments. Complete with all accessories as shown. **£17** plus 15/- carr. Leaflet on request.

100 WATT POWER RHEOSTATS

(NEW) Ceramic construction, winding embedded in Vitreous Enamel, heavy duty brush assembly designed for continuous duty.
AVAILABLE FROM STOCK IN THE FOLLOWING 11 VALUES:
1 ohm 10a., 5 ohm 4.7 a., 10 ohm 3 a.; 25 ohm 2 a.; 50 ohm 1.4a.; 100 ohm 1 a.; 250 ohm .7 a.; 500 ohm. 45 a.; 1,000 ohm 280 mA.; 1,500 ohm 230 mA.; 2,500 ohm .2 a. Diameter 3½in. Shaft length ⅞in. dia., ¼in. **27/6**. P. & P. 1/6.

50 WATT POWER RHEOSTATS

1 ohm, 7a.; 5 ohm, 3a.; 10 ohm, 2.25a.; 25 ohm, 1.4a.; 50 ohm, 1a.; 100 ohm, .7a.; 250 ohm, .45a.; 500 ohm, .3a.; 1,000 ohm, .22a.; 2,500 ohm, .14a. All at **21/-** each. P. & P. 1/6.

25 WATT POWER RHEOSTATS

10 ohm 1.5 a.; 25 ohm 1 a.; 50 ohm .75 a.; 100 ohm .5 a.; 250 ohm .3 a.; 500 ohm .2 a.; 1,000 ohm .15 a.; 1,500 ohm .12 a.; 2,500 ohm .1 a.; all at **14/6**. each. P. & P. 1/6.

SWING ARM RHEOSTAT

Especially designed for educational use. 0-10 ohm in precision 1 ohm steps. Max. current 5 amp. Size: Height 19in. Width 11⅞in. Depth 6½in. Price **£4/19/6**. P. & P. 7/6.

MOVING COIL HEADPHONES

Finest quality soft chamois earmuffs. Superb reproduction. Complete with jack plug, **25/6** P. & P. 2/6.
MOVING COIL HEADPHONE AND MIKE. Soft rubber ear-pieces with M/C Mike fitted 5-way plug as on No. 19 set. New in makers packing 16/6 plus 3/6 C. & P.

SANWA Multi Range Meters

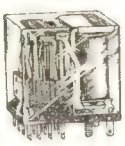
We now stock just one make of multi range meters **SANWA.** Acknowledged throughout the world as the ultimate in test meters.
Four types from stock. Price from **£3.2.0**, full range of spares and repair service available. Descriptive leaflet on request.

L.T. TRANSFORMERS

All primaries 220-240 volts.

Type No.	Sec. Taps	Price	Carr.
1	30, 32, 34, 36 v. at 5 amps.	£3/5/0	6/-
2	30, 40, 50 v. at 5 amps.	£5/5/0	6/6
3	10, 17, 18 v. at 10 amps.	£3/10/0	4/6
4	6, 12 v. at 20 amps.	£4/17/6	6/6
5	17, 18, 20 v. at 20 amps.	£5/12/6	6/6
6	6, 12, 20 v. at 20 amps.	£5/5/0	7/6
7	24 v. at 10 amps.	£3/15/0	5/6

A.C. AMMETERS 0-1, 0-5, 0-10, 0-15, 0-20 amp. F.R. 2½in. dia. All at **21/-** each.
A.C. VOLTMETERS 0-25 v., 0-50 v., 0-150 v. M.I. 2½in. Flush round all at **21/-** each. P. & P. extra.
0-300 v. A.C. Rect. M-Coil 2½in. **29/-**
0-300 v. A.C. Rect. M-Coil 3½in. Type W23.. **55/-**



Latest type SIEMENS MINIATURE RELAY in Transparent Case. 4 c/o 700 ohm **14/6**. Base **4/-**. 2 c/o 700 ohm coil, size ¾×¾×1⅜in. **15/-** inc. base.
VARLEY TYPE VP4 (similar to illus.), 5,800 ohm, 4 c/o. New, **12/6**, less base.
Similar to above. Mfd. by GRUNER, 4 c/o, 2,400 ohm coil. New, **10/-**, less base.

MINIATURE UNISELECTOR SWITCH

3 banks of 11 positions plus homing bank. 40 ohm coil. 24-36 v. D.C. operation. Carefully removed from equipment and tested. **22/6**, plus 2/6 P.&P.

STANDARD SIZE UNISELECTOR SWITCHES

75 ohm coil, 24 v. D.C., 6 bank 25 position, 5 non-bridging, 1 bridging wiper 6 bank arranged to give 3 banks, 50 positions. These switches have been carefully removed from equipment. All at **35/-** each. P. & P. 2/6.

BTAND NEW 4 Bank 25 Way Uniselector, 3 Bank + Homing, 25 ohm coil, 12-24 v. D.C. operation, **£4/17/6** plus 2/6 P. & P.

SUPER POWER ALLOY MAGNET

These fantastic ex WD magnets weighing only 4lbs. will lift well over 100lbs. Fitted with swivelled handle and keeper. Size 4in.×3¾in. ×1¾in. Packed in original makers' cases of two. Price **30/-** per pair, plus 7/6 P. & P.

NICKEL CADMIUM BATTERY

Sintered Cadmium Type 1.2 v. 7AH. Size: height 3½in., width 2⅜ × 1⅞in. Weight: approx. 13 ozs. Ex-R.A.F. Tested, **12/6**. **P. & P. 2/6.**

THYRISTOR 400 piv, 3 amp., **9/6** post paid
THYRISTOR 400 piv, 8 amp., **28/6** post paid

NEW SOUNDPOWER OPERATED EX-ADMIRALTY HEAD AND BREAST SETS

Two such sets connected up will provide perfect intercom. No batteries required. Will operate up to ¼ mile. Price **17/6** each plus P. & P. 4/6 or **32/6** per pair. P. & P. 6/-.

ALL MAIL ORDERS. ALSO CALLERS AT:
57 BRIDGMAN ROAD, LONDON, W.4. Phone: 995 1560
Closed Saturdays.

SERVICE TRADING CO.
SHOWROOMS NOW OPEN
Many Bargains for the caller.
AMPLE PARKING

PERSONAL CALLERS ONLY
9 LITTLE NEWPORT STREET, LONDON, W.C.2.
Tel.: GER 0576

Lasky's Radio

DEMONSTRATION STUDIOS

Lasky's High Fidelity Sound Centres

With the opening of our latest branch to be devoted exclusively to High Fidelity equipment, **118 Edgware Road, London, W.2**, we have created a companion and complementary Hi-Fi Centre to the now famous **42 Tottenham Court Road, W.1.** Together these Centres offer you the unique facility of seeing and hearing all the latest equipment by all the World's leading manufacturers together with a wide range of equipment cabinets and speaker enclosures. Our experienced staff are on hand to help you plan a complete system and to select the equipment most suitable to your requirements. In addition we are often able to offer a considerable cash saving when you choose a complete system.

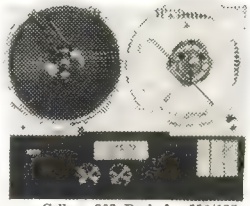
If you cannot call at any of our branches please send details of your requirements to our head office and we shall be pleased to quote without obligation. We operate the "Purchase Tax Free" scheme for overseas visitors. Full H.P terms available.

PACKAGE DEALS

A Lasky's "Package Deal" allows you to purchase the complete Audio System of your choice at a worthwhile cash saving. We shall be pleased to quote our "Package Deal". Prices for any selection of equipment of your own choice. Send us details of your requirements. **H.P. and Easy Credit Terms can be arranged on "Package Deals."**

TAPE RECORDERS

MAGNAVOX 363 TAPE DECKS



The very latest 3 speed model—1⅞, 3¾, 7½ i.p.s., available with either ¼ track or ½ track head. Features include: pause control; digital counter; fast forward and rewind; new 4 pole fully screened induction motor; interlocking keys. Size of top plate 13¼ × 11 × 6¼in. deep below unit plate. For 200/250 v. A.C. mains, 50 c.p.s. operation. New unused and fully guaranteed.

LASKY'S PRICE ¼ track model **£10.10.0** Carriage and Packing 7/6 extra

LASKY'S PRICE ½ track model **£13.9.6**

SPECIAL FOR OVERSEAS CUSTOMERS—the new Magnavox-Collaro 363 Deck for 110/125 v. 50 or 60 c.p.s. mains now available, prices as above. Post to any part of the world. **35/-.**

NEW MARTIN TAPE RECORD REPLAY AMPS.

Now available from stock—for use with the Magnavox 363 Tape Deck.

¼ track model .....**LASKY'S PRICE £14/19/6** Carriage &

½ track model .....**LASKY'S PRICE £15/19/6** Packing 4/6 extra

Optional Extra: Control panel escutcheon to tape deck and amplifier controls.

LASKY'S PRICE 12/6. Post & Packing 2/6.

OUTSTANDING VALUE—THE 'TELETON' 701

7-TRANSISTOR TWO-SPEED CAPSTAN DRIVE MAINS/BATTERY RECORDER

An outstandingly high quality machine that is unparalleled for value. Performance is equal on both mains and battery, excellent music and speech characteristics make this the ideal home or office recorder.

Look at these outstanding features:

● 7 transistor and 3 diode circuit—800mW output. ● Two speed, 1⅞ and 3¾ i.p.s., capstan drive system (wow and flutter better than 0.3% at 3¾ i.p.s.). ● Built-in 110/240 v. A.C. convertor for mains operation or uses 4 × 1.5 v. batteries. ● Takes 5in. spools giving 3 hrs. twin track recording at 1⅞ i.p.s. and 1½ hrs. at 3¾ i.p.s. ● Fast forward and rewind. ● Twin track A.C. bias recording system—frequency response 100 to 7,000 c/s. ● Record level meter (acts as battery check on replay). ● Piano key function controls, plus vol. and tone controls. ● Continental type 5 pin inputs for microphone, telephone adaptor pick-up and direct recording from radio or other recorder; switched input for earphone. ● 2½ × 4½ P.M. Dynamic speaker. ● Plastic cabinet in two-tone grey with chrome metal trim and carrying handle. ● **Accessories:** Dynamic stick microphone with clip on stand, telephone pick-up, 5in. spool of tape and empty spool, earphone, direct recording lead mains lead with plug, batteries and instruction book with circuit comp. with all accessories. Fully guaranteed.

LASKY'S PRICE 24 GNS. Post free.

NEW INTERNATIONAL TAPE

FAMOUS AMERICAN MADE BRAND TAPE AT RECORD LOW PRICES

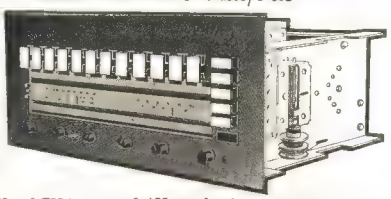
3in. Message tape, 150ft.	2/6	5¼in. Long play, 1,200ft. Acetate	12/6
3in. Message tape, 225ft.	3/9	5¼in. Standard play, 850ft. P.V.C.	11/6
3in. Message tape, 300ft.	7/6	5¼in. Triple play, 2,400ft. Mylar	45/-
3½in. Triple play, 600ft. Mylar	10/-	5¼in. Long play, 1,200ft. Mylar	15/-
4in. Triple play, 900ft. Mylar	17/6	7in. Standard play, 1,200ft. Acetate	12/6
5in. Double play, 1,200ft. Mylar	15/-	7in. Standard play, 1,200ft. Mylar	12/6
5in. Long play 900ft. Acetate	10/-	7in. Long play, 1,800ft. Mylar	19/6
5in. Standard play, 600ft. P.V.C.	8/6	7in. Double play, 2,400ft. Mylar	25/-
5in. Triple play, 1,800ft. Mylar	35/-	7in. Long play, 1,800ft. Acetate	15/-
5½in. Double play, 1,800ft. Mylar	22/6	7in. Triple play, 3,600ft. Mylar	50/-

1/- Post extra per reel; 4 reels and over Post Free.

Musicassettes—over 200 titles in stock, Philips, Mercury, Fontana, C.B.S., Pye, Reprise, W.B. Send S.A.E. for full list.

AMPLIFIERS

SOLID STATE MULTIPLEX STEREO AM/FM TUNER AMPLIFIER CHASSIS



Model T10E—made for U.K. use by famous North American manufacturer and originally installed in De Luxe Hi-Fi console costing several hundred pounds. The chassis is of outstanding appearance and quality and offers many unique features plus an extremely comprehensive spec.

Features ● Separate transistorised AM and FM tuners ● 3 AM wavebands—LW, MW and Continental T.R. band ● full FM cover with 5 push-button preselected stations (sep. tuning controls for AM and FM ranges) ● built-in multiplex decoder with unique FMX feature which provides automatic switching from mono to stereo where stereo signal is received and vice versa ● unique split amplifier facility for simultaneous play of radio plus any other source ● channel reverse ● switched inputs for tape and auxiliaries (sep. sockets for tape in and out) ● switched extension speaker outlet ● thermal safety trip ● socket for stereo headphones. **TECH. spec.:** Output 10 watts RMS per channel; output imp. 8 Ω p.c.; sensitivity 50 mV for 8W output at 1 Kc.; input imp. 100K Ω p.c.; 12 unique tumbler type function controls, 8 push-button wavechange and station selection controls, vol., bass, treble and balance controls, push-button contour (loudness) control; illuminated tuning scale; AM ranges; MW 520-1640 kc/s., LW 140-290 kc/s., Continental TR 170-345 kc/s.; FM range 88-108 Mc/s with switched AFC. Operates on 200/250 V. A.C., 50 or 60 c/s. Size: 17½ × 8 × 12in.

LASKY'S PRICE 59 GNS. Post & Packing 20/-.

SANSUI MODEL MP-2 STEREO MULTIPLEX DECODER

A superbly high quality auxiliary decoder for use with an FM stereo Tuner/Amplifier without multiplex or with a stereo amplifier and sep. FM tuner without multiplex. The unit is housed in a free standing hammer enamel metal cabinet with brushed aluminium control panel and knobs—size 4½ × 4½ × 12½in. Controls for power on/off filter (interference reducer) and dimension (separation) control. Power on neon and stereo beacon which lights when stereo signal is received. **Brief Spec.:** 3 valves with Germanium and Silicon Diodes; Frequency response: 50 c/s to 15 Kc/s — 2dB.; Channel separation: over 35 dB at Kc/s.; distortion less than 1% at 0.2-3 v. input signal. Operates on 200/250 v. A.C. Complete with connecting leads and full instructions. **LASKY'S PRICE £9.19.6** Post 5/-.

SPEAKERS

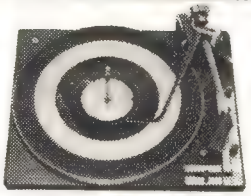
FOSTER FCS 104 BOOKSHELF SPEAKER SYSTEM

A new high quality bookshelf speaker system by the well known Foster Co. of Japan. This system incorporates the latest developments in speaker miniaturisation and has a performance equal to many larger and more expensive units. The sealed infinite baffle type housing is finished in high quality teak veneer. The system comprises a 4in. dual range speaker, tweeter and crossover network—for 8 W, 16 Ω imp. operation. Screw tag connections at rear. Cabinet size 9½ × 6½ × 6¾in.

LASKY'S PRICE £9.19.6. 2 for £18.0.0.

Post 1—5/-; 2—8/6.

RECORD PLAYERS



B.S.R. AUTOCHANGERS NEW LOW PRICES

Fully guaranteed complete with cartridge and stylus

UA16 9v. battery model **£5 19 6**

UA20 4-speed mains model **£5 19 6**

NEW—B.S.R. UA70 (Illustrated left)

4 speed mains autochanger superb modern styling at amazingly low price.

LASKY'S PRICE **£9/19/6** (ex cartridge)

GARRARD AUTOCHANGERS

AT60	£10	19	6	A1000	£6	6	0
AT6 Mk. II	£10	19	6	A2000	£6	16	6
3000LM with stereo cartridge	£8	19	6	**GARRARD BASES**			
A70	£19	9	0	WB1	£3	16	3
Lab. A Mono/Stereo	£14	19	6	WB2	£5	5	0
Lab. A on plinth	£15	19	6	**CLEARVIEW PERSPEX COVERS**			
A50	£7	7	0	WB1	£3	17	0
				WB2	£5	7	11
TRANSCRIPTION MOTORS				**SINGLE PLAYERS**			
GARRARD 401	£30	9	0	Auto. start and stop. Complete with pick-up and crystal cartridge.			
GARRARD Lab. 80, Mk. II	£30	7	2				
CONNOISSEUR				EMI with Stereo cartridge	£3	19	6
Craftsman II	£17	2	11	COLLARO Junior 4-speed	£3	9	6
Craftsman III	£22	19	6	GARRARD SRP12	£4	7	6
Model B	£25	4	0	GARRARD SRP10 mains model	£4	19	6
LENCO GL58	£17	1	9	GARRARD SRP10 batt. model	£4	19	6
LENCO GL68	£19	10	7	GARRARD SP25 Light t/table	£9	19	6
LENCO G88	£15	15	0	GARRARD SP25 Heavy t/table	£10	19	6
LENCO GL70	£29	18	8	*(Garrard SP25's are ex-cartridge)*			
LENCO G99	£21	19	5	PHILLIPS AG/1016	£12	12	0
THORENS TD135 I	£26	5	0	BRAUN PC4L Stereo	£8	19	6
THORENS TD135 II	£40	5	8				
THORENS TD124 II	£40	5	8				
THORENS TD150	£20	13	2				

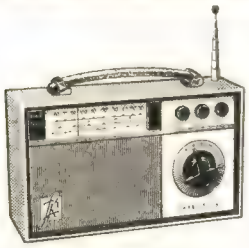
All other current models available. Postage on all above 5/- extra.

LASKY'S RADIO FOR FINEST VALUE and COURTEOUS SERVICE

WW—129 FOR FURTHER DETAILS

Lasky's Radio

CONSTRUCTORS BARGAINS



THE SKYROVER DE LUXE

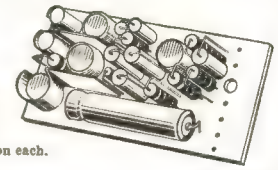
7 transistor plus 2 diode superhet, 6 waveband portable receiver covering the full Medium Waveband and Short Waveband 31-94M and also 4 separate switched bandspread ranges, 13M, 16M., 19M., and 25M., with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is factory assembled, wired and tested. Superhet, 470 Kc/s. Mullard Transistors. Uses 4 U2 batteries. 5in. Ceramic Magnet P.M. Speaker, 500 MW Output. Telescopic Aerial and Ferrite Rod Aerial. Tone Circuit. In wood cabinet, size 11½ × 6½ × 3in., covered with washable material, plastic trim and handle. Car aerial socket fitted.

Can now be built for £8.19.6 Post 5/- extra.

H.P. Terms: 60/- deposit and 11 monthly payments of 12/9. Total H.P.P. £10/0/3.

Data 2/6. Refunded if you purchase parcel. Four U2 batts, 3/4 extra. All components avail. sep. A simple additional circuit provides coverage of the 1100/1950M. Long Waveband. All necessary components with construction data. **Only 10/- extra. Post Free. This conversion is suitable for receivers already constructed.**

LASKY'S MINIATURE TRANSISTOR AMPLIFIER MODULES



Incorporating the very latest circuitry to provide high sensitivity and good quality in conjunction with extremely small size and compactness. High quality Newmarket transistors used throughout. All designed to operate on 9 v, miniature battery. **Add 1/- P. & P. on each.**

TYPE LRPC 1. 3 transistor. Input sens. 50mV., output 150mW. output imp. 40Ω size 2×1×¾in. ..... **PRICE 27/6**

TYPE LRPC 4. 5 transistor. Input sens. 150mV., output 330mW., output imp. 15Ω., size 2¼×1½×¾in. ..... **PRICE 18/6**

TYPE LRPC 5. 6 transistor. Input sens. 8mV., output 3W., output imp. 3Ω. size 5½×1¾×1in. ..... **PRICE 59/6**

LRPC 9. High to Low input matching preamplifier. Input imp. 1 megohm, output imp. 2 k/ohms. Size 1¼×1½×¾in. ..... **PRICE 10/6**

LRPC 10. Magnetic tape replay preamp. designed so that a 450 mH head can be matched into any of the audio amp. modules listed above. Size 2½×1½×¾in. ..... **PRICE 10/6**
Note the **LRPC 9** and **10** are ideal for use with the **LRPC 1, 4** or **5** and are **available at the reduced price of 7/6 if bought with the LRPC 4.**

FULLY ENCAPSULATED MODULES
Special function modules—all one size 1¼×1×1¼in. Complete with detailed function and installation instructions. Send S.A.E. for specification sheets.

TYPE PA-1. Public address amp. for use with carbon, crystal or Dynamic microphones. 3Ω output imp. ..... **LASKY'S PRICE 30/-**

TYPE GR-1. Gramophone amp.—provides sufficient power to fill average room. 3Ω output imp. ..... **LASKY'S PRICE 30/-**

TYPE CO-1. Morse code practice oscillator—for use with morse key and 3Ω speaker ..... **LASKY'S PRICE 20/-**

TYPE MT-1. Metronome module—provides audible and visual beat from 30 to 240 beats per minute (for use with 3Ω speaker)..... **LASKY'S PRICE 22/6**

SINCLAIR SUPER MINIATURES

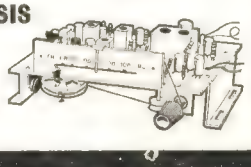
We stock the complete range. Write for details of package deals.

The Micro 6 miniature radio kit ..	£2 19 6	**THE Z-12** 12 watt amp. and pre-amp., fully built	£4 9 6
THE MICRO-FM (tuner/receiver) kit	£5 19 6	**PZ-3 POWER PACK** for Z-12....	£3 19 6
The Micromatic miniature radio kit	£2 19 6	**STEREO 25** pre-amp. control unit, fully built.	£9 19 6
Fully built and tested	£3 19 6		

BARGAIN—UHF TV TUNERS

Well known British maker's surplus stocks. Now available for the first time to the Home Constructor. Add 2/6 Post and Packing.
VALVE UHF MODEL. In metal case, size 4×6×1½in. Fully tunable—complete with PC86 and PC88 valves. **LASKY'S PRICE** with valves, **29/6.** Without valves **7/6.**

TRANSISTOR FM TUNER CHASSIS



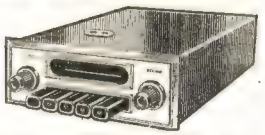
Fully tunable—range 88 to 108 Mc/s. Completely wired on printed circuit. 10.3 Mc/s. IF. 6 transistors and 3 diodes. Slow motion tuning drive. Size 6¼×4×2¼in. Operates from any 9 v. D.C. source. Full data and circuit supplied.

LASKY'S PRICE £7.19.6 Post 5/- extra.

SPECIAL INTEREST ITEMS!

TWO BAND TRANSISTOR CAR RADIO BARGAIN!

MODEL CR-62



A new high-quality imported all-transistor superhet car radio that really breaks the quality/price barrier. Unique features of this set are the four M/W band station pre-selection buttons which you yourself set to your own four favourite stations—this is in addition to full M/W band cover over 150-300 kc/s (IF frequency 455 kc/s). Externally adjustable aerial trimmers ensure maximum output. Six transistor (including one drift type) and one diode circuit provides powerful 2 W. output. The set is adjustable for use on either pos. or neg. ground 12 v. systems (external line fuse fitted). Standard mounting size 6¾×5¾×2in.—front panel ¼in. larger all round—finished in anodised aluminium with black push buttons. Complete with mounting brackets, full installation instructions and 2 baffle boards (for round or elliptical speaker). Fully guaranteed.

LASKY'S PRICE £9.19.6 Post 5/-. 6 × 4in. elliptical 8 Ω dynamic speaker 17/6 extra—Post FREE.

***SPECIAL OFFER*—LOCKING CAR AERIAL**
Model 83003 five section 40in. extension heavy chrome telescopic wing mounting type with unique locking device to protect the antenna when closed Complete with mounting bracket, lead and plug and two "keys."

LASKY'S SPECIAL PRICE 39/6 Post Free with the Royal CR-62. Sep. Post 2/6.

LASKY'S PANEL METERS

Precision made in clear plastic HIOKI of Japan. Each meter boxed and fully guaranteed with all fixing nuts and washers. Sizes are of front panel. Spec. quotes for quantities.

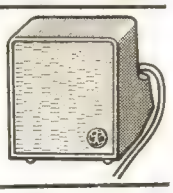
Add 1/6 post on each.

TYPE KR-52 3×2½in. (illus.)		300 V. D.C.	32/6
1 mA. D.C.	32/6	500μA	37/6
5 mA. D.C.	32/6	1 mA S Meter	39/6

TYPE MK-38A 2in. square		**TYPE MK-45A 1½in. square**	
1 mA DC	22/6	1 mA DC	25/-
5 mA DC	22/6	5 mA DC	25/-
300 V DC	22/6	300 V DC	25/-
500μA	27/6	500μA	25/-
1 mA S Meter	29.6	1 mA S Meter	35/-
TYPE KR-65 3½×3in.		**TYPE MK-65A. 3in. square**	
1 mA DC	36/-	1 mA DC	36/-
5 mA DC	35/-	5 mA DC	35/-
300 V DC	35/-	300 V DC	35/-
500μA	42 6	500μA	39/6
1 mA S Meter	39.6	1 mA S Meter	37/6

MICROPHONE BARGAIN

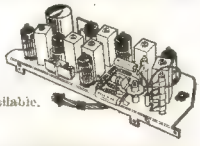
STC MODEL 414



A high quality omni-directional moving coil microphone—suitable for use with sound reinforcement and P.A. systems, tape recorders, transistor amplifiers, etc. Attractive grey moulded case for free standing or hand held use—size 2½×2½×2¼in. Complete with 6ft. screened cable. New and unused in maker's cartons—fully guaranteed.

Type A. Low imp. 200Ω. **LASKY'S PRICE £1.19.6** Post
Type B. High imp. 50KΩ. **LASKY'S PRICE £2. 5. 0** 2/-.

TELEVISION IF AMPLIFIERS



Famous Maker's Surplus. 38 Mc/s. Contains a large number of components: IF transformers, resistors, capacitors, etc., and the following valves: 2×PCF80, 1×EB91, EF80, EF183 and EF184. Overall size 11½×3¼×4in. deep. Ideal for servicemen and experimenters. This IF amplifier when used with the Valve model UFH Tuner provides suitable conversion for B.B.C 2. No circuit available.

LASKY'S PRICE 29/6 Post & Packing 2/6.

COMMUNICATION RECEIVERS

NEW FANTAVOX HE 50

Covers full medium waveband and 1.6-4.5 Mc/s. 4.5-12.0 Mc/s. and 11.0-30.0 Mc/s. in separate switched band spread ranges. Two aerials are fitted an internal loop and external telescopic. Controls include: B.F.O. Sensitivity. C.W. A.N.L receiver/stand-by. S meter. Easy to read illuminated dial with logging scale. For 200/250 v. A.C. 4 valve plus rectifier. Fitted with internal speaker and socket for phones or external speaker. Cabinet size 13½×8¼×5½in. Complete with full instruction manual.

LASKY'S PRICE 16 Gns. H.P. Terms available. Post 10/-.

Branches
207 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 3271
33 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-636 2605
Open all day Saturday, early closing 1 p.m. Thursday
152/3 FLEET STREET, LONDON, E.C.4 Tel.: FLEet St. 2833
Open all day Thursday, early closing 1 p.m. Saturday

High Fidelity Audio Centres
42 TOTTENHAM CT. RD., LONDON, W.1 Tel.: 01-580 2573
Open all day Thursday, early closing 1 p.m. Saturday
118 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 9789
Open all day Saturday, early closing 1 p.m. Thursday

ALL MAIL ORDERS AND CORRESPONDENCE TO: 3-15 CAVELL ST., TOWER HAMLETS, LONDON, E.1 Tel.: 01-790 4821

WW—130 FOR FURTHER DETAILS

BRADFORD 10 North Parade. Tel. 25349. (Half-day Wed.)

BRISTOL 14 Lower Castle Street. (Half-day Wed.) Tel. 22904.

BIRMINGHAM 30-31 Gt. Western Arcade. Opp. Snow Hill station. Tel. CENtral 1279 (No half-day). Larger premises now open.

DARLINGTON 13 Post House Wynd (Half-day Wed.). Tel.: 68043.

DERBY 26 Osmaston Rd. The Spot. (Half-day Wed.). Tel.: 41361.

EDINBURGH 133 Leith St. Tel.: Waverley 5766 (Half-day Wed.).

GLASGOW 326 Argyle Street. Tel.: CITy 4158 (No half-day). **403 Sauchiehall Street.** Opp. Locarno. Tel. 332-1572.

HULL 91 Paragon Street. (Half-day Thursday). Tel.: 20505.

R·S·C
HI-FI CENTRES LTD.

MAIL ORDERS TO: 102 Henconner Lane, Bramley, Leeds, 13. Terms: C.W.O. or C.O.D. No C.O.D. under £1. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with all enquiries please. Hi-Fi Catalogue price 4/6 post paid. Personal shoppers welcomed at our Hi-Fi CENTRES above. OPEN ALL DAY SATS. Except High Holborn.

ALL LEADING MAKES OF HI-FI EQUIPMENT CASH OR TERMS.

LEICESTER 32 High Street. (Half-day Thurs.) Tel.: 56420.

LEEDS 5-7 County Arcade, Briggate. Tel.: 28252. (No half-day).

LIVERPOOL 73 Dale St. (No half-day). Tel.: CENtral 3573.

LONDON 238 Edgware Rd. W.2. (Half-day Thurs.). Tel.: PAD 1629. 96 High Holborn, W.C.1. Tel.: HOL 9874. (Half-day Sat.)

MANCHESTER 60A-60B Oldham St. (No Half-day). Tel.: CENtral 2778.

MIDDLESBROUGH Tel.: 47096 106 Newport Rd. (Half-day Wed.)

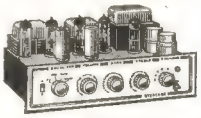
NEWCASTLE 41 Blackett Street. (Half-day Wed.). Tel.: 21469.

SHEFFIELD 13 Exchange Street, Castle Market Bldgs. (Half-day Thursday) Tel.: 20716.

New range of Linear HI-FI units stocked

R.S.C. STEREO/20 HIGH FIDELITY AMPLIFIER

Providing 10/14 WATTS ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL



Features include:
★ **Four-position tone compensating and input Selector switch.**
★ **Stereo Mono switch so that peak monaural output of 28 watts can be obtained.**
★ **Separate "Bass" "lift" and "cut" and treble "lift" and "cut" controls.**
★ **Neon panel indicator.**
★ **Handsome Perspex Frontplate.** Complete set of parts with point-to-point wiring diagrams and instructions or Factory assembled, tested and supplied with Carr. **14 Gns.** 12 months' guarantee for **19 gns.** or DEPOSIT **£3** and 9 monthly payments **43/2** (Total 12/6 **£22/8/6**.) SUITABLE for "MIKE" GRAM., RADIO OR TAPE. FOR HOME OR STUDIO. Employing valves ECC83, ECC83, ECL86, ECL86, ECL86, ECL86, EZ81. Output transformers are high quality sectionally wound to required specification. Output matchings for 3 and 15 ohm speakers. FREQUENCY RESPONSE ±2dB 30-20,000 c.p.s. HUM LEVEL −65dB. SENSITIVITY: 15 millivolts. HARMONIC DISTORTION 0.2 per cent. For 200/250 v. A.C. mains. Send S.A.E. for leaflet.

HIGH FIDELITY LOUDSPEAKER ENCLOSURES

All types are of pleasing modern design acoustically lined and ported, and in alternative finishes of light teak or medium walnut.

J.E.S. Size 22 × 11 × 8in. Gives pleasing results with any 8in. Hi-Fi speaker. Only **£4/19/9**

SE8. Designed for optimum performance with any Hi-Fi 8in. spkr. Size 22×15×9in. Carr. 7/6. **£5/19/9**

SE10. For High-Fidelity Speaker with provision for tweeter. Size 24×15×10in. Carr. 10/-. **£6/19/9**

SE12. For outstanding performance with any 12in. Hi-Fi speaker. Tweeter cut-out provided. Size 25×16×10½in. Carr. 10/-. **8 Gns.**

R.S.C. STEREO 10 HIGH QUALITY AMPLIFIER

Valves EZ81, ECC83, ECC83, EL84, EL84. Separate bass and treble controls giving "cut" and "boost." Sensitivity 50mV. 5 watts high quality output on each channel. Can be used as straight 10 watt amplifier. Controls: Stereo/Monaural switch, ganged volume, ganged treble, ganged base and balance. Output for 3 ohms speaker. Point-to-point wiring diagrams and instructions. Or assembled and tested **11 gns.** Deposit **36/-** and 9 monthly pyts. **25/5** (Total **£13/4/9**). S.A.E. for leaflet. Carr. 11/6. **£8/15/0**

HIGH FIDELITY LOUDSPEAKER UNITS

All types have handsome cabinets, of latest styling finished in Satin Teak or Walnut, acoustically lined and ported.

FULTON. 8 watts, 3-8-15 ohms. Fitted Vol. Control. Ideal ext. unit for Tape Recorder etc. Size 11" high, 14" long, 7" deep. Inc. Audiotrine HF 810 cast chassis 8" speaker. Response 45-13,000 cps. **£5/15/0** Carr. 7/6.

The GLOUCESTER Size 25 × 16×10in. Fitted 12in. high flux speaker, Cross-over unit, and Tweeter. Rating 10 watts. Smooth response. 40-20,000 c.p.s. Impedance 15 ohms. Carr. 15/-. **12½Gns.**

The BRONTE. Size 22×15 ×9in. Fitted Wharfedale Super 8 RSDD or Audiotrine HF 815D Speaker, with Roll Surround and dual cone. 6-10 watts. Impedance 3 or 15 ohms. Carr. 16/6. Rating **13 Gns.**

CREDIT TERMS. Deposit 3/- in £1. Balance over 9 mths.

The DORSET Size 16×11 ×8in. Response 45-18,000 c.p.s. Rating 10 watts. Fitted Audiotrine HF 811D speaker. Impedance 3 or 15 ohms. Carr. 9/6. **£8/19/9**

The DORCHESTER. Size 24×15×10in. Fitted Audiotrine HF101D Speaker. Rating 12 watts. Frequency response 30-20,000 c.p.s. Impedance 3 or 15 ohms. Carr. 15/-. **12½ Gns.**

CELESTION DITTON 10. 10 watts rating, 15 ohms impedance. **Limited number** Normally £19/15/7. **£14/5/7**

AUDIOTRINE HI-FI TAPE RECORDER KIT

Only 4 pairs of soldered joints plus mains.

Build a high quality recorder in the £50 class for only

Can be assembled in one hour. S.A.E. for leaflet. 4 track 3 gns. extra OR DEPOSIT 4 gns. and 9 monthly payments of 59/6 (Total 29½ gns.). Cash price if settled in 3 months **26½ Gns.** Carr. 19/6. INCORPORATING THE LATEST MAGNAVOX TAPE DECK, THE AUDIOTRINE HIGH QUALITY TAPE AMPLIFIER, A HIGH FLUX 7 × 4in. LOUDSPEAKER, Reel of Best Quality TAPE, Spare Tape Spool, a Portable Cabinet size approx. 17½ × 14½ × 8½in. finished Grey leathercloth with Silver trim and chrome fittings. Connection diagram for wiring, amplifier to deck provided. FEATURES INCLUDE ★ 3-SPEEDS ★ FREQUENCY RESPONSE 50-11,000 cps. ★ SWITCHED TONE COMPENSATION FOR EACH SPEED ★ OUTPUT 4 WATTS ★ MAGIC EYE RECORDING LEVEL INDICATOR ★ HEAVY DUTY MOTOR ★ TAPE MEASURING & CALIBRATING DEVICE ★ TAKES FULL 7in. DIAMETER REELS OF TAPE ★ NEGLIGIBLE HUM ★ ENTIRELY EFFECTIVE AUTOMATIC ERASURE.

R.S.C. SUPER 15 HI-FI AMPLIFIER

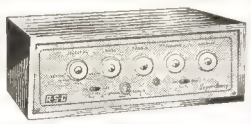
FULLY TRANSISTORISED

★ **200-250 v. A.C. Mains Operation**
★ **OUTPUT R.M.S. CONTINUOUS** 10 WATTS into 15 ohms. 15 WATTS into 3 ohms.
★ Max. Instantaneous Peak Power Output 28 watts.
★ SOLID STATE CONSTRUCTION
★ **LATEST MULLARD TRANSISTORS** AD 149 (2), OC127Z, OC81Z (2), OC44 (3), AC107 (Total of 9).
★ **5-POSITION INPUT SELECTOR SWITCH EQUALIZATION** to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
★ **FULL TAPE MONITORING FACILITIES**
★ **SENSITIVITIES:** Magnetic P.U. 4 m.v. Crystal or Ceramic P.U. 400 mv. Microphone 4.5 mv. Tape Head 2.5 mv. Radio/Aux. or Ceramic P.U. 110 mv.
★ NEGATIVE FEEDBACK 52 dB.
★ FREQUENCY RESPONSE: 20-20,000 c.p.s. ±2dB.
★ TREBLE Control +15 dB. to −14 dB. at 10 kc/s.
★ BASS Control +12 dB. to −15 dB. at 50 c/s.
★ HARMONIC DISTORTION AT 10 watts R.M.S. 1,000 c.p.s. 0.25%.
★ HUM LEVEL: −75 dB.

Send S.A.E. for leaflet.

TECHNICAL SPECIFICATIONS COMPARE MORE THAN FAVOURABLY WITH SIMILAR AMPLIFIERS AT ALMOST TWICE THE COST

Complete Kit of parts with full constructional details and point-to-point wiring diagrams. 11½ Gns. Carr. 12/6



Unit factory built **15½ gns.** Terms: Deposit **49/-** and 9 mthly pyts. **35/-** (Total **£18/4/-**). Or fitted in walnut or teak veneered cabinet as illustrated. **4 gns.** extra. Carr. 12/6.

All parts, point-to-point wiring diagrams and detailed instructions. 19 Gns. Carr. 15/-.

Unit factory built **26½ gns.** or Deposit **83/9** and 9 monthly payments **59/3** (Total **£30/17/-**). Fitted cabinet as above **30 gns.** Carr. 15/-. Or Dep. **£4/15/6** and 9 mthly. pyts. **67/-** (Total **£34/18/6**).

AUDIOTRINE HI-FIDELITY LOUDSPEAKERS

Heavy cast construction. Latest high efficiency ceramic magnets, Dual Cone for extended frequency range. Plastic treated surround giving low resonant frequency. Response 40-18,000 c.p.s. Impedance 3 or 15 ohms. Post free.

HF800D	**8in. 8 Watt, 59/9**	**HF120**	**12in. 12 Watt, 69/9**
HF811D	**8in. 10 Watt, £4/19/9**	**HF120D**	**12in. 12 Watt, 79/9**
HF110D	**10in. 8 Watt, 69/9**	**HF126**	**12in. 15 Watt, 89/9**
HF101D	**10in. 15 Watt, £5/19/9**	**HF126D**	**12in. 15 Watt, 6 gns.**
		HF127D	**12in. 30 Watt, 9 gns.**

AUDIOTRINE HI-FI SPEAKER SYSTEM

Provides a smooth frequency response from 40-20,000 c.p.s. Consisting of 12in. 12,000 line 15 ohm speaker. Crossover Unit and Tweeter. Highly recommended for use with any High-Fidelity Amplifier Carr. 6/9.
10 Watt Unit 5 Gns.
20 Watt Unit with extra heavy bass speaker 7 gns. Carr. 8/9.

A DUAL CHANNEL VERSION OF THE SUPER 15 Employing Twin Printed Circuits

★ Matched Components.
★ Close Tolerance Ganged Pots.
★ CROSS-TALK −52 dB. at 1,000 c.p.s.
★ CONTROLS: (1) 5 Position Input Selector. (2) Bass. (3) Treble. (4) Vol. (5) Balance. (6) Stereo/Mono Switch. (7) Tape Monitor Switch. (8) Mains Switch.
★ INPUT SOCKETS (Matched Pairs): (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Mic. Operation of the Input Selector Switch assures appropriate equalization.
★ Rigid 18 s.w.g. Chassis. Size 12×3×8in.
★ Attractive Rigid Perspex Facia Plate and Spun Silver Matching Knobs.
★ NEON PANEL INDICATOR.

Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15. ALL HIGH GRADE COMPONENTS, ETC. THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). SUPERB SOUND OUTPUT CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT.

AUDIOTRINE PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6 Mk. II, AT60, SP25 or Goldring GL68. Or with clear Perspex cover as illustrated, **66/-** **£5/19/11** complete. Carr. 8/6.

RP2 HI-FI SINGLE RECORD PLAYING UNITS. Consisting of the popular Garrard SP25 turntable and Goldring CS90 High compliance ceramic Cartridge with diamond stylus. Fitted on Plinth as above and complete with Clear Perspex cover. Ready to 'plug-in' to any Hi-Fi amplifier. (Normal Price £25.) TERMS: Deposit **3 gns.** and 9 monthly payments **43/7.** (Total **£22/15/3**). Carr. 15/-. **19½ Gns.**

MODEL RP3. As above but with Goldring Lenco GL 68 Transcription Unit and CS 90 Cartridge. Normally over £33. Our price 26½ GNS. Carr. 15/-. Terms available. RP3M with Pickering Magnetic Cartridge 34½ Gns.

R.S.C. TFM1 TRANSISTORISED VHF/FM RADIO TUNER

★ **200-250 v. A.C. Mains operation**
★ **High Sensitivity**
★ **Drift-free reception**
★ **Sharp A.M. Rejection**
★ **Output ample for any amplifier approx. (500 mV.)**
★ **Simple alignment instructions**
★ **Output available for feeding tuning meter**
★ **Output for feeding Stereo Multi-plexer**
★ **Tuner head using Silicon Planar Transistors**
★ **Designed for standard 80 ohms co-axial input**
★ **Stereo Version now available**

Total cost of parts with detailed wiring diagrams and instructions. **12½ Gns.** Carr. 10/-.

Or factory built, **15½ gns.** Or in Teak finished cabinet as illustrated **19½ gns.** Terms: Deposit **£5** and 9 mthly. pymts. **39/-**. (Total **£22/11/-**)

Made to match our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry, only first grade transistors and components used. Our latest product giving you the best at half the cost of comparable units.

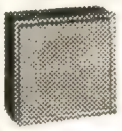
GLASGOW - LONDON

New branches open. See opposite page

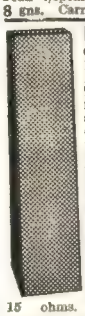
LINEAR LP1 TAPE PRE-AMPLIFIER

Switched Equalisation. For 1⅞in., 3¾in., 7½in. per sec. EM84 Recording Level Indicator. Designed as the link between a Magnavox Tape Deck and Hi-Fi amplifier. Suitable almost any Tape Deck. Cash or Terms. S.A.E. for leaflet. **10½ Gns.**

LOUDSPEAKERS IN CABINETS Teak veneered



12in. 10 WATT. Size 15×15×8in. approx. High quality 12in. 10 watt 12,000 line speaker, 3 ohms or 15 ohms **5 gns.** Carr. 7/6.
12in. 20 WATT HEAVY DUTY. High Quality High Flux 1/speaker. 15 ohms. Size 18×18×8in. **8 gns.** Carr. 10/6. Rexine covered **£1** extra.



R.S.C. COLUMN SPEAKERS

Covered in two-tone Rexine/Vynair Ideal for vocalists and Public Address. 15 ohm matching. **Type C58. 15-20 WATTS.** Fitted five 8in. high flux speakers. Overall size approx. 42×10×5in. or Deposit **44/-** and 9 monthly pymts. **34/9.** (Total **£18/1/6**) **15 Gns.** Carr. 10/-.
Type C412. 40 WATTS. Fitted four 12in. 12,000 line 10 watt speakers. Overall size approx. 56×14×9in. Carr. 15/- Or Deposit **£3/13/-** and 9 monthly payments of **50/-** (Total **£26/3/-**). **22 Gns.**

H/DUTY L'SPEAKERS

Limited number brand new. All 15 ohms. Credit terms available.

18in 60 watt Normally approx. £25 **18 GNS.** Carr. 15/-
15in 40 watt Normally approx. £19 **12 GNS.** Carr. 15/-
12in 30 watt Normally approx. £13 **8 GNS.** Carr. 10/-
12in 20 watt Dual Cone **£5-11-9** Carr. 5/9.

POWER PACK KITS

Fully smoothed output 250 v. 60 mA. H.T. and L.T. 6.3 v., 1.5 amps. Consist of chassis. Double wound Mains Trans 200-250 v. Rectifier. Choke. Electrolytics and circuit. Or with case in lieu of chassis **26/11.** Or assembled **39/11** **22/11**

R.S.C. TRANSFORMERS

Fully Guaranteed. Interleaved and Impregnated.

MAINS TRANSFORMERS. Primaries 200-250 v. 50 c/s.

MIDGET CLAMPED TYPE 2½×2½×2¼ins.
250 v. 60 mA. 6.3 v. 2 a. 14/11
250-0-250 v. 60 mA., 6.3 v. 2 a. 15/11

FULLY SHROUDED, UPRIGHT MOUNTING
250-0-250 v. 60 mA., 6.3 v. 2 a., 0-5-6.3 v. 2 a. 2½-3-3in. 19/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 33/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 33/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t. 6.3 v. 1 a. For Mullard 510 Amplifier 41/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 33/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 42/9
425-0-425 v. 200 mA., 6.3 v. 4 a. c.t. 5 v. 3 a.. 67/9
425-0-425 v. 200 mA., 6.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a. 69/9
450-0-450 v. 200 mA., 6.3 v. 4 a. c.t., 5 v. 3 a... 79/9

TOP SHROUDED DROP-THROUGH TYPE
250-0-250 v. 76mA., 6.3 v. 2 a., 0-5-6.3 v. 2 a. 19/9
250-0-250 v. 100 ma., 6.3 v. 3.5 a. 21/9
250-0-250 v. 100 mA., 6.3 v. 2 a., 6.3 v. 1 a. .. 22/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 0-5-6.3 v. 2 a... 23/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 32/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 32/9
300-0-300 v. 130 mA., 6.3 v. 4 a., 0-5-6.3 v. 1 a., suitable for Mullard 510 Amplifier 39/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 32/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a. 39/11

FILAMENT OR TRANSISTOR POWER PACK TYPE
12 v. 1 a. 8/9; 6.3 v. 1.5 a. 6/9; 6.3 v. 2 a. 7/9; 6.3 v. 3 a. 9/9; 6.3 v. 6 a. 19/9; 12 v. 3 a. or 24 v. 1.5 a. 19/9; 0-9-18 v. 1½ a. 15/9; 0-12-25-42 v. 2 a. 27/9.

AUTO (Step UP/ Step DOWN) TRANSFORMERS
0-110/120 v. 200-230-250 v. 50-80 watts..... 14/9
150 watts 29/11; 250 watts 49/9; 500 watts.. 99.9

CHARGER TRANSFORMERS. 0-9-15 v. 1½ a. 13/11; 2½ a. 16/11; 3 a. 18/11; 5 a. 21/11; 6 a. 25/11; 8 a. 31/11.

OUTPUT TRANSFORMERS
Standard Pentode 5,000Ω to 3Ω or 7,000Ω to 3Ω 7/9
Push pull 8 watts EL84 to 3Ω or 15Ω 11/9
Push pull 10-12 watts 6V6 to 3Ω or 15Ω 19/9
Push pull 10-12 watts to match 6V6 to 3, 5, 8 or 15Ω 21/9
Push pull EL84 to 3 or 15Ω 10-12 watts..... 19/9
Push pull Ultra Linear for Mullard 510, etc. 35/9
Push pull 15-18 watts, sectionally wound 6L6, KT66, etc., from 3 or 15Ω 29/9
Push pull 20 watt high-quality sectionally wound EL34, 6L6, KT66, etc., to 3 or 15Ω, fully shrouded 55/9

SMOOTHING CHOKES
250 mA. 5 H., 100Ω 12/9; 80 mA., 10 H. 350Ω 7/9; 150 mA., 7-10 H., 250Ω 12/9; 60 mA., 10 H., 400Ω 4/11
100 mA., 10 H. 200Ω 9/11.

R.S.C. TA6 6 WATT HIGH FIDELITY AMPLIFIER

SOLID STATE CONSTRUCTION

For 200-250 v. A.C. Mains. Frequency Response 30-20,000 c.p.s. —2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble "lift" and "cut" controls, 3 input sockets for "Mike," Gram, Radio or Tape. Input Selector Switch. Output for 3-15 ohm. speakers. Max. sensitivity.5 mV. Fully enclosed enamelled case, 9½×2¾×5¼in. Attractive brushed silver facia plate 10½×3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Or factory built with 12 mths.' guarantee **£7/19/11.** Carr. 7/6 **6 GNS.**

R.S.C. A10 30 watt AMPLIFIER *HIGH FIDELITY*

ULTRA LINEAR PUSH-PULL OUTPUT

SIX VALVES EF86, EF86, ECC83, 807, 807, GZ34. Integral Tone Control Pre-amp. stages. Only 12 millivolts input required for full output. **THIS ENSURES THE SUITABILITY OF ANY TYPE OF MICROPHONE OR PICK-UP.** Separate Bass and Treble controls give both "lift" and "cut." Two inputs with separate vol. controls permit simultaneous use of "mike," pick-up, etc., etc. **AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 v. 1.5 A. FOR A RADIO TUNER.** Price in kit form with easy to follow wiring diagram. ONLY Carr. 12/6. **12 Gns.** Or factory built using latest EL34 output valves with 12 months' guarantee. **15 GNS. TERMS ON ASSEMBLED UNITS. DEPOSIT £2/8/-** and 9 monthly payments of **33/7** (Total **£17/10/3**). Protective cover with handles available for **21/-.**
Type 807 ouput valves are used with High Quality Sectionally Wound output transformer. Negative feedback of 20 dB. in main loop. **CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ±3 dB. 30-20,000 c/s. Tone Controls. 12 dB. at 50 c/s + 12 dB. to —6 dB. at 12,000 c/s. hum and noise 70 dB. down. Good quality reliable components used. Chassis finish gold hammer. Overall size 12×9×9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohms speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS. IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR 'POP' GROUPS, GARRISON THEATRES, etc., etc. We can supply Microphone Speakers, etc., etc., at keen cash prices or on terms with amplifiers. EXPORT INQUIRIES INVITED.**

R.S.C. A11 12-14 WATT AMPLIFIER

HIGH FIDELITY ULTRA LINEAR OUTPUT

"BUILT-IN" TONE CONTROL PRE-AMP STAGES. Two input sockets with associated control allow mixing of "mike" and gram., etc. High sensitivity. 5 valves ECC83, ECC83, EL84, EL84, EZ81. High quality sectionally wound output transformer. Reliable components. BASS AND TREBLE CONTROLS "Lift" and "Cut." Frequency response ±3 dB. 30-20,000 c/s. Six negative feedback loops. Hum level—60dB. Sensitivity 23 mV. For use with all types of pick-ups and mikes. Comparable with the very best designs. For grams, radio, or tape. For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS,** etc. **OUTPUT SOCKET** with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO TUNER.** Size approx. 12×9×7in. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohms speakers. Complete set of parts with instructions and point-to-point wiring diagrams. **£8.15.0** Carr. 11/6.
Or factory built **£11/15/-. TERMS: DEP. 36/6** and 9 monthly payments of **25/9** (Total **£13/8/3**). Perforated metal cover with 2 handles can be supplied for **21/-.** Carr. 11/6.

A11T FULLY TRANSISTORISED VERSION Complete kit **9 Gns.,** Carr. 9/6.

LOUDSPEAKER CORNER CONSOLE CABINETS

Attractive polished walnut finish. Discontinued designs at approx. half price

STANDARD MODEL Size 28×19×12in. for 10in. Speaker **59/11**

SENIOR MODEL Size 31½×22½×14in. for 12 in. Speaker and Tweeter **5 Gns.**

R·S·C·TA12 13 WATT STEREO AMPLIFIER

Fully transistorised. High fidelity output of 6.5 watts per channel. Switched Inputs (1) P.U. (2) Tuner (3) P.U. (4) Mic. **11 Gns.** Carr 10/6.
Send for leaflet. Complete kit.

TAPE AMPLIFIERS

Size 11in.×2¼in.×6in.

Suitable for use with Magnavox Decks. For 200-250 v. mains A.C. Originally 13 gns. Limited number slightly store soiled at only **£6.19.11** Carr. 7/6.

R.S.C. 4/5 WATT AS HIGH GAIN AMPLIFIER

A highly sensitive 4-valve quality amplifier for the home, small club, etc., suitable for all crystal or ceramic P.U. heads and practically all "mikes" Separate Bass and Treble controls giving "lift" and "cut," Hum level 71 dB. down.

Negative feed back 13 dB. Reserve power supply 300 v. H.T. and 6.3 v. L.T. for Radio Tuner or Tape Deck Pre-amp. For A.C. mains 200-250 v. Speaker output 3 ohms. Kit complete in every detail. Fully punched enamelled chassis, point-to-point wiring diagrams and instructions. Assembled, ready for use **£6/6/-.** **£4.17.9**

R.S.C. BATTERY ELIMINATORS

Type BM1. Size 5½×4½×2in. approx. Completely replaces batteries supplying 1.5 v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available. Complete kit with diagrams **47/9**
Or **59/11** ready for use.

R.S.C. 4 watt GRAM AMPLIFIER KIT 59/11

Complete set of parts to build a good quality compact unit suitable for use with any record playing unit. Mains isolated chassis. Separate Bass and Treble controls. Output for 2-3 ohms speaker. For 200-250 v. A.C.

JASON VHF/FM TUNERS FM1 £6.19.11

Complete kit with valves. Carr. 5/-.

TRANSISTOR SALE

Mullard OC71, OC81, OC72. **2/11;** OC45, OC44, **3/11;** OC75 **7/9;** OC71 **8/9;** AF117 **6/9;** Ediswan XA101 XA112, XC101A **3/9.** Postage 6d. for up to 3 transistors.

HEAVY DUTY SELENIUM RECTIFIERS Only 19/9

F.W. (Bridged). 12 v. 15 amps.

SELENIUM RECTIFIERS F.W. (Bridged) All 6/12 v. D.C. output

Max. A.C. input 18 v.
1 a. 3/11; 2 a. 6/11; 3 a. 9/9; 4 a. 12/9; 6 a. 15/9.

INTEREST CHARGES REFUNDED

on Credit Sale purchases settled in 3 months.

R·S·C HI-FI CENTRES LTD.

MINIATURE KEY SWITCHES. (P.O. Lever Type 1000), centre off. 2 c/o each way. 7/6 ea.
RE-SETTABLE HIGH SPEED COUNTER (3 × 1 × ⅝in.) 3 digit. 12/24/48 v. (state which), **32/6** ea. P.P. 2/6.
HIGH SPEED MAGNETIC COUNTERS (4×1×1in.) 4 digit. 12/24/48 v. (state which), **6/6** ea. P.P. 1/-.
SOLARTRON REGULATED POWER SUPPLY (SRS 152) 0-500 v. 200 m.a. 6.3v. 5a. **£17/10/-** P.P. 50/-.
SANGAMO GEARED MOTOR. 1 r.p.m. 240 v. 27/6 ea.
COPPER LAMINATE PRINTED CIRCUIT BOARD (8½×5½×$\frac{1}{16}$in.), 2/6 sheet, 5 for 10/-.

BULK COMPONENT OFFERS
100 Capacitors (latest types) 50pF to .5μF.
250 Resistors ½ and ¼ watt.
250 Resistors ½ and 1 watt.
150 Hi-Stab Resistors, ¼, ½ and 1 watt.
25 Vitreous W/W Resistors, 5%.
12 Precision Resistors 1% (several standards included).
12 Precision Capacitors 1 and 2% (several standards included).
12 Electrolytics (miniature and standard sizes).
ANY ITEM 10/-. ANY 5 ITEMS £2

VENNER LIGHTWEIGHT ACCUMULATORS (1 oz. 1¾ × 1¾×¾in.) 2 v. 1.5 a.h., **12/6** ea. (with electrolyse and charging inst.).
CARPENTER POLARISED RELAY 18,000 turns at 4000Ω **15/-** (with base). ALL Types of G.E.C./SIEMENS/ S.T.C. Sealed relays stocked.
MAINS RELAY (240 v. A.C.). 12 H.D. make contacts, 20/- ea., p.p. 2/6.
REED RELAYS (2 Herkons) S.T.C. 2426-582-15, 2 make. 10-15 volt coil, **15/-** ea.
"3000" TYPE RELAYS (Ex. New Equip.) 10 for 25/- (our choice), p.p. 5/-.
SYNCHRONOUS CHOPPERS (A.E.I.) CK4. Reed tuned 100 c/s., 25/- ea.
AMPLIFIED TELEPHONE HANDSET. Type 706 with built-in transistor amplifier and volume control, 35/- ea., p.p. 2/6.
ANALOGUE-DIGITAL CONVERTERS (Solartron type LP 1115), **£20** ea.
TELEPHONE CONNECTING WIRE (internal) Twin twisted. Copper Conductor 250 yd. Coils 25/-, p.p. 5/-.
THYRISTOR LAMP DIMMER/SPEED CONTROL KITS. 200 watt kit, **27/6,** P.P. 2/6; 500 watt kit, **37/6,** P.P. 2/6.
SILICON CONTROLLED RECTIFIERS (Thyristors) BTY87 (100r) 100 p.i.v. 12 amp., **15/-** ea.; TBY91 (150r) 150 p.i.v. 16 amp., **20/-**; CRS25/10 100 p.i.v. 25 amp., 30/-; CRS25/40 400 p.i.v. 25 amp., **60/-**; CRS1/20 200 p.i.v. 1 amp., **5/6**; CRS1/40 400 p.i.v. 1 amp., **7/6**; CRS3/40 400 p.i.v. 3 amp., **10/-** ea.
SILICON DIODES. RS220af **2/-** ea.; **£1** doz.; RS240 **3/-** ea., 30/- doz.; RS280 **4/-** ea., 40/- doz.; IS103/BY100 **4/-** ea., 40/- doz.; RAS310af (avalanche) **6/-** ea., 60/- doz.; IS413 **5/-** ea., 50/- doz.; RS610, **10/-** ea. RS640 20/- ea.; RS812 40/- ea.; RS845 60/- ea.
PRODUCTION BATCH COUNTER (BURNDEPT) BE403. Condition: New **£15** ea., P.P. 20/-.
OSCILLOSCOPES. Cossor 1035, **£17/10/-**; 1049, **£20**; Solartron D300, **£20,** P.P. any unit **£2/10/-.**
TRANSISTOR CIRCUITS TESTER. Output Meter + 1 k/c. Oscillator + 0.25 v. ½ amp. Power Supply, **£7/10/-**, P.P. 15/-.
STEREO OUTPUT AND BALANCE METERS. Checks both channels simultaneously. Up to 20 watts into 3/8/15 ohms. **£10** ea.
SILICON BRIDGE UNITS. GEX541 80 p.i.v. 10a., 37/6; EIIBD-RC 100 p.i.v. 10a., 37/6; GA31-A (Germ.). 200 p.i.v., 2a., 20/-.
SORENSON VOLTAGE REGULATORS. Type LT-1000-2S. £25 ea.
P.C. CONNECTORS (13 way in-line), **4/6** pair.
ELECTROLYTICS. 100μF 60v., 2/6; 100 + 60μF 275v. 4/-; 100 + 200μF, 275 v. 5/-; 200μF. 250v. 3/6; 250μF. 100v. 3/6; 250μF. 275v. 4/-; 400 + 100μF. 275v. 5/-; 500μF. 100v. 4/-; 1000μF. 50v. 5/-; 5000μF. 50v. 7/6; P.P. 2/6 in £1.
SPEAKER BARGAINS. E.M.I. 13×8in. with double Tweeters 15 ohm. 65/-, P.P. 5/-. As above less tweeters 3 or 15 ohm. 45/- ea., P.P. 5/-.
FANE 12in. 20 watt (Dual Cone), 95/-, P.P. 5/-.
PHASE SENSITIVE VOLTMETERS (Solartron UP250/253). £65.
TRANSFORMERS L.T. 50v. at 5 amp. 19-0-19v. ½ amp. 25/-, P.P. 5/-.
TRANSFORMERS H.T. 625-0-625v. at 110 m.a., 6.3v. at 2a., 6.3v. at 3a. c.t. Parmeko Neptune series, 35/-. P.P. 5/-.
ELECTRIC SLOTMETERS (1/-) 25 amp. L.R. 240v. A.C., 85/- ea., P.P. 5/-.
QUARTERLY ELECTRIC CHECK METERS 40 amp. 240v. A.C., 20/- ea., P.P. 5/-.
TRANSISTOR POWER SUPPLY. 2×12v. at 250 m.a. 240v. 50 c/s. input, 25/- ea., P.P. 5/- (made by E.M.I.).
STEP-DOWN TRANSFORMERS. PRI. 200/250v. Sec. 1. 115v. at 1.25 amps.; Sec. 2. 25v. at 5 amp., 25/- ea., P.P. 5/-.

PATTRICK & KINNIE

81 PARK LANE, HORNCHURCH, ESSEX

Tel.: ROMFORD 44473

PRE-PAK SEMICONDUCTORS DISTRIBUTED EXCLUSIVELY BY BI-PRE-PAK LTD. DEPT. B. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX PHONE: SOUTHEND (0502) 46344

★ FANTASTIC! BARGAINS OF THE YEAR! ★

No.		PRICE
A1.	6—Silicon rectifiers BY100	20/-
A2.	10—Relays mixed types and voltages	20/-
A3.	20—Mixed marked and tested trans.	20/-
A9.	1—2N 174 real power trans. 80V 150W	20/-
A15.	2—Power Comp. Pair AD161/2	20/-
A17.	3—Sil. stud recs. 6 amps. 400 PIV. BYZ12	20/-
A18.	2—Sil. stud recs. 10 amp. 800 PIV	20/-
A20.	1—AUY10 VHF power trans. 60 Mc/s. 70 V.	20/-
B1.	50—Unmarked untested, trans., new	10/-
B2.	4—Solar cells, inc. Book of Instructions	10/-
B3.	4—OA5 gold bonded, diodes Mullard	10/-
B5.	7—Matched set, OC44, 45/81D/81 + diode	10/-
B6.	15—Red spot AF trans. or white spot RF	10/-
B8.	2—Power trans. Oc26/35 type	10/-
B9.	1—Light sensitive cell, ORP 12 type	8/-
B10.	10—50 V. trans. germ. P.N.P., latest type	10/-
B44.	1—Tunnel diode, AEY11, 1050 MC/s.	10/-
B21.	2—Sil. recs. 10 amp., 50-100 PIV	10/-
B52.	30—Trans. new tested, but unmarked	10/-
B42.	5—Switching trans. TK22C STC	10/-
B45.	1—Power trans. ADY22/TK400A VCB60 IC 8 amps. PNP	10/-
B47.	10—Sil. stud recs. 3 amps. unmarked, untested	10/-
B49.	2—Power trans. GET 9 VCB64 IC 8 amps. germ. PNP	10/-
B50.	2—Light sensitive cells ORP60 type	10/-
C2.	1—Uni junction, 2N2160 or 2N646	15/-
C4.	2—RF power trans., OC22 and BUY11	15/-
C31.	4—Sil. recs. 800 PIV ¾ amp. top hat	15/-
C32.	2—Power trans. TK400A/NKT404 VCB64 IC 8 amps	15/-

GENUINE TRANSISTORS NOT REMARKS

OC45	IF transistor	1/9	OA9	Equal to OA5	2/-
OC44	Osc. transistor	1/11	OC36	Power transistor (better than OC35)	7/6

NEW FACTORY TESTED PRE-PAKS. ALL PERFECT BUT UNMARKED

50	GERM. MIN.	DIODES 10/-	30	ALL TYPES	TRANSISTORS 10/-
10	SILICON 750 mA TOP HAT	RECTIFIERS 10/-	40	SILICON SUB. MIN.	DIODES 10/-
5	3 AMP. SILICON	STUD. RECS. 10/-	10	N.P.N. SILICON	TRANSISTORS 10/-

TRANSISTORS	PRICE
AC107	6/-
AC126	2/6
AC127	2/6
AC128	3/-
ACY17	5/-
AF114	4/-
AF115	3/-
AF116	3/-
AF117	4/-
AF118	3/6
AF119	3/6
AF178	10/-
ASY66	2/-
BCZ11	7/6
BFY50	15/-
BSY25	10/-
BSY26	5/-
BSY27	5/-
BSY28	5/-
BSY29	5/-
BSY95A	5/-
OC41	2/6
OC71	2/6
OC72	2/6
OC73	5/-
OC81	2/6
OC81D	2/6
OC83	4/-
OC139	2/6
OC140	5/-
OC170	2/6
OC171	4/-
OC200	5/-
OC201	8/-
2G301	2/6
2G303	2/6
2N697	5/-
2N706	5/-
2N711	10/-
2N1302	4/-
2N1303	4/-
2N1304	5/-
2N1305	5/-
2N1306	6/-
2N1307	6/-
2N1308	8/-
2N1309	7/6
28303	2/6
POWER TRANSISTORS	
OC20	10/-
OC23	10/-
OC25	8/-
OC26	5/-
OC28	5/-
OC35	5/-
DIODES	
AAY42	2/-
OA10	2/-
OA70	1/9
OA79	1/9
OA81	1/9
OA182	2/-
IN914	1/6

'FREE' ★ ★ Packs of your own choice to the value of 10/- with all orders over £4.

SCOOP PURCHASE! Pre-assembled logic elements. 2 input gates 2/-. 3 input gates 2/9. Flip Flops and others 5/- each. Send for more details.

LARGE RANGE — LOW PRICE SILICON CONTROLLED RECTIFIERS. SEND FOR FULL RANGE AND CIRCUIT DIAGRAMS. FREE OF CHARGE.

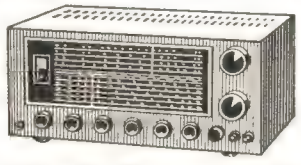
GREAT NEWS ★ ★ We now give a written guarantee with all our semi-conductors.

FIRST EVER LOGIC KITS. Learn for yourself how computers work, even make one for yourself. Full instructions for noughts and crosses machine, binary counters, timers, etc. L1 5 gns. L2 10 gns. No need to purchase both kits, you can start with L.2 which incorporates L.1. DETAILS FREE.

MAKE A REV COUNTER FOR YOUR CAR. THE 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a perfectly linear and accurate rev counter for any car. State 4 or 6 cylinder. **20/- each**

NO CONNECTION WITH ANY OTHER FIRM. MINIMUM ORDER 10/-. CASH WITH ORDER PLEASE. Add 1/- post and packing per order. OVERSEAS ADD EXTRA FOR AIRMAIL.

TRIO DELUXE COMMUNICATION RECEIVER 9R-59



4 Bands. 550-1,600 kc/s. 1.6-4.3 Mc/s., 4.8-14.5 Mc/s., 10.5-30 Mc/s. 8 valve Superhet. 1 RF plus 2 IF Stages. Built-in Q Multiplier. Aerial trimmer. AVC-MVC, BFO, AM, CW & SSB S-meter. Carr. 10/-. PRICE **30gns**

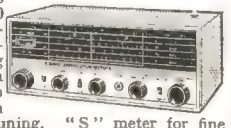
GARRARD RECORD PLAYER BARGAINS

Brand New with maker's Guarantee

AUTOCHANGERS		SINGLE PLAYERS	
Model 1000	£5.15.6	Model SRP12	£4. 4.0
Model 2000	£7. 7.0	Model SP25	£9.19.6
Model 3000	£7.19.6	Carr. 8/6 each.	
Model AT6MK11	£9. 9.0	All complete with t.o crystal cartridge.	
Model AT60	£9.19.6	Send S.A.E. for full list of other Garrard units.	
Model AT60 Mk.II	£11.11.0		

WOODEN BASE. Teak finish with rigid Perspex cover suitable for any of above units (except SRP.12) £5/15/-. Carr. 5/-.

FANTAVOX COMMUNICATIONS RECEIVER HE.50



4 wavebands 540 kc/s. to 30 Mc/s. Exceptionally sensitive tuning circuit. Extra large easy to read dial with Bandspread tuning. "S" meter for fine tuning. Built-in speaker and telescopic aerial. BFO. 'Phone output socket. Standby switch, etc. A.C. 200/250 v.

Gee's Price P. & P. 10/-. **Only 15gns**

SUPER POWER LOUDHAILER

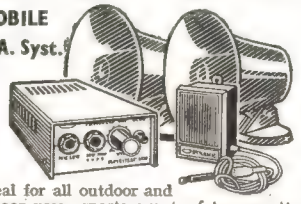
Range 1,000 ft. Light weight, self-contained portable dynamic directional type microphone with cardoid polar diaphragm. **12gns**

Fully transistorised power amplifier. Long battery life. Ideal for all outdoor events. Junior Model £4/15/-. P. & P. 2/6.

NEW TRANSISTORISED INSULATION - RESISTANCE TESTER Model PDM.500.

Push button operation. Large, easy to read scale dial. Handy vinyl-leather carrying case. Rated voltage and resistance 500v./100 meg. ohm. Scale range: 0.1-100-200 megohm. Size 6⅞×4⅝×2⅝in. **£18.18.0**

MIGHTY MIDGET 12 VOLT PORTABLE MOBILE P.A. Syst.



Ideal for all outdoor and indoor uses—sports events, fetes, regattas, van salesmen, etc., etc. 12 volt 16 watt. Amplifier size only 1⅝ × 3⅜ × 5⅞in., with inputs for mike, radio and tape recorder. Can be mounted on any car or boat etc. Complete with dynamic microphone and mounting brackets. PRICE **12gns**

TU 25 REFLEX HORN SPEAKERS. Strong and durable, weatherproof, waterproof and shockproof. 20½in. dia. 25 watts output. 15 ohms impedance. Freq. response 100-10,000 c.p.s Gives excellent reproduction of speech and music.

Carr. 15/- **£11.11.0** (TU. 35,35 watt model, £12/19/6.)

12in. REFLEX HORN SPEAKERS. 8 ohms imp. 10 watts output. Freq. response 450-6,500 c.p.s. Waterproof, shockproof, lightweight. Attractive dark blue finish. **7gns** Each

Also 5in. dia. 5 watts. 3 gns. each.

GEE'S TAPE

Attractively boxed. Guaranteed Brand new.

5in.	Std.	600ft.	8/6
7in.	Std.	1,200ft.	12/6
5in.	L.P.	900ft.	10/-
5½in.	L.P.	1,200ft.	12/6
7in.	L.P.	1,800ft.	15/-
4in.	D.P.	600ft.	9/-
5in.	D.P.	1,200ft.	15/-
5½in.	D.P.	1,800ft.	22/6
7in.	D.P.	2,400ft.	25/-
3in.	T.P.	600ft.	12/6
4in.	T.P.	900ft.	15/-
5in.	T.P.	1,800ft.	30/-
5½in.	T.P.	2,400ft.	40/-
7in.	T.P.	3,600ft.	50/-

P. & P. 2/6 per order.

SEND 1/- FOR ILLUSTRATED CATALOGUE OF TAPE AND AUDIO ACCESSORY BARGAINS

½in. COMPUTER TAPE. 2,400ft. on 10½in. NARTB metal spool. British manufacture. Brand new, unused fresh stock. Few only available. £6 post paid.

GEE BROS. RADIO

15 LITTLE NEWPORT STREET, LONDON, W.C.2 GER. 6794/1453

Open 9-6 Mon-Fri., 1 p.m. Sat. Adjoining Leicester Square Tube

VIKING TRANSISTOR

40-50 WATT AMPLIFIER

OPERATING INSTRUCTIONS, GENERAL. An extremely reliable lightweight amplifier capable of giving 40-50 watts of undistorted sound, made possible by the use of the latest semi-conductors (transistors) and techniques which ensure space-age reliability under the most rugged conditions. It is designed as a general purpose amplifier particularly suitable for use with musical instruments that require exceptionally high treble response (not recommended for Bass Guitar). Tremolo facilities are available on Channel 1 only. **INPUTS—CONTROLS—CHANNEL 1 (Tremolo).** This contains two high gain input jack sockets controlled by **Volume Control 1** which is mounted directly above the two sockets marked Tremolo. **BASS 1.** Gives a controlled boost to the lower frequencies on Channel 1 only. **TREBLE 1.** Gives a controlled boost to the high frequencies on Channel 1 only. **TREMOLO.** This operates on Channel 1 only and the variations of intensity and speed of the Tremolo beat is adjusted by the controls DEPTH and SPEED. A socket is provided in the rear of the amplifier so that the Tremolo may be switched on and off by the use of a footswitch plugged into the socket. If you wish the Tremolo to be used without the footswitch, this is possible as the footswitch is only used to short out the effect. **INPUTS AND CONTROLS—CHANNEL 2 (Normal).** This contains two high gain input jack sockets controlled by **Volume Control 2** which is mounted directly above the sockets marked **Normal. TREBLE.** Gives a controlled boost to the treble frequencies on Channel 2 only. **MAINS VOLTAGE.** Fully adjustable. 200-250 volts A.C., 50 cycles. **POWER OUTPUT** 40-50 watts sine wave British rating. Very little distortion. **OUTPUT IMPEDANCE** 3 ohms. **Price 21 gns.**, plus £1 postage and packing.

MAINS TRANSFORMER, primary 200/250 volts, secondary 425/425 volt, 250 mA, 6.3 volt 4 amp. 5 volt 3 amp; fully shrouded, chassis mounting. **Price £2/5/-**, plus 7/6 postage and packing. Auto transformer step-up-step-down, 240/110 volt 400 watt. **Price £1/5/-**, plus 7/6 postage and packing.

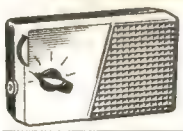
MAINS TRANSFORMER, 200/250 volt, secondary 250/250 volt 70 mA 6.3 volt. 3 amp drop-through. **Price 12/6**, plus 4/6 postage and packing.
Elac 10in., 10,000 lines ceramic magnet, 3 or 15 ohms 7 watt. **Price £1/9/6**, plus 4/6 postage and packing.

8 VALVE STEREO RADIOGRAM CHASSIS

3-4 WATTS PER CHANNEL *By Famous Manufacturer*

Superb new 8-valve chassis covering long, medium and short waves on AM, also VHF transmissions on FM. AM circuits high sensitivity permits internal aerial for most stations. Well-known Gorler tuning heart in separate FM input. Tone and volume controls. Extra large illuminated dial. External AM and FM aerial inputs. Gram. pick-up socket. Standard 3 ohm speaker. 200/250 volts A.C. Size 17×7×5¼in. deep. **£14.14.0** P. & P. £1.

NEW Transistorised SIGNAL GENERATOR

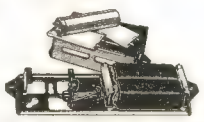


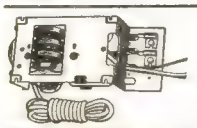
Size 5½×3½×1½in. For I.F. and R.F. alignment and A.F. output. 700 c/s. frequency coverage 460 kc/s. to 2 Mc/s. in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. P. & P. 3/6. **39/6**

POWER SUPPLY KIT

A.C. Mains 200/250 v.

Incorporating "C" core type mains transformer, full wave metal rectification and smoothing condenser. Smooth output 250 v. 250 mA and 6.3 v. 4 amp., for Heaters. **25/-** P. & P. 9/6.



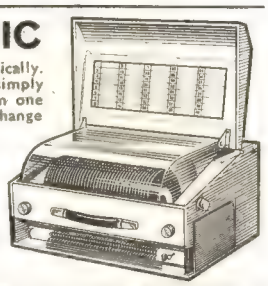


TRANSISTORISED 1½ WATT AMPLIFIER

comprising Mullard 2AC, 128, 20C, 75 and 2 AA129 separate bass and treble volume controls. Complete with Power Supply A.C. mains, 240 v. Size 7½×3¾×2in. **Price 50/-**, plus 2/6 P. & P.

The KB DISCOMATIC

Provides 7½ hours of continuous music automatically. It plays up to 40 7in. 45 r.p.m. discs (80 sides) simply by pressing as many pre-selected buttons from one to eighty as required. At any time you can change your selections while playing. Or you can change the entire 40 discs by taking out one rack, inserting another. Complete with interior light, extension speaker sockets and transistorised amplifier. Dimensions: 10½in. high × 20in. wide × 18in. deep. A.C. mains 240 v. Personal shoppers only. List price 73 gns. plus 10% P.T. surcharge.



Our Price Only **33 gns.**

RADIO AND T.V. COMPONENTS (ACTON) LTD

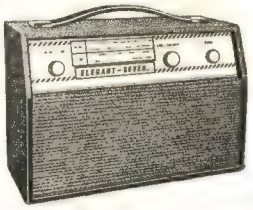
21A HIGH STREET, ACTON, LONDON, W.3.
SHOP HOURS 9 a.m. to 6 p.m. EARLY CLOSING WEDNESDAY.
Goods not despatched outside U.K. All enquiries stamped add. envelope. Terms C.W.O.

'ELEGANT SEVEN' MK IIA

Power supply kit to purchasers of "Elegant Seven" parts, incorporating mains transformer, rectifier and smoothing condenser. A.C. mains 200/250 volts. Output 9 v. 100 mA. 9/6 extra.

- ★ De luxe grey wooden cabinet size 12½×8½×3¼in.
- ★ Horizontal easy to read tuning scale printed grey with black letters, size 11½×2in.
- ★ High "Q" ferrite rod aerial.
- ★ I.F. neutralization on each separate stage.
- ★ D.C. coupled push pull output stage with separate A.C. negative feedback.
- ★ Room filling output 350 mW.
- ★ Ready etched and drilled printed circuit board back printed for foolproof construction.
- ★ Fully comprehensive instructions and point-to-point wiring diagrams.
- ★ Car aerial socket.
- ★ Fully tunable over medium and long wave. 168-535 metres and 1,250-2,000 metres.
- ★ All components, ferrite rod and tuning assembly mount on printed board.
- ★ 5in. P.M. Speaker.
- ★ Parts list and circuit diagrams 2/6, free with parts.

SPECIAL OFFER



ONLY **£4.4.0** Plus 7/6 P. & P.

Buy yourself an easy to build 7 transistor radio and save at least £10. Now you can build this superb 7 transistor superhet radio for under £4/10/-. No one else can offer such a fantastic radio with so many de luxe star features.

ANTI-THIEF CAR BURGLAR ALARM

The Melguard Safermatic consists of an electrical device housed in small metal box 4×2×1¾in., which has been designed and developed to provide protection required by the average motorist at an economic cost. Using this system, an alarm and the immobilised condition is set automatically as soon as you park the car. Should you leave the key in the ignition, no one but you can drive the car away. Upon entering the vehicle the method of starting the car is by switching on the ignition, depressing two hidden switches and simultaneously operating the starter. Location of the switches is known only to you. Should the alarm be set off it can be stopped by following the normal starting procedure. For 12 v. operation. List price 79/6. **OUR PRICE 29/6** plus 2/6 P. & P. Full easy-to-follow instructions supplied.

FIRST QUALITY PVC TAPE

5¼in.	Std.	850ft.	9/–	5in.	L.P.	850ft.	10/6	POST & PKG.
7in.	Std.	1,200ft.	11/6	3in.	T.P.	600ft.	10/6	ON EACH
3in.	L.P.	240ft.	4/–	5in.	T.P.	1,800ft.	25/6	1/6.
5¼in.	L.P.	1,200ft.	11/6	5¼in.	T.P.	2,400ft.	32/6	4 OR MORE
5¼in.	D.P.	1,800ft.	18/6	7in.	T.P.	3,600ft.	42/6	POST FREE.
7in.	L.P.	1,800ft.	18/6	4in.	T.P.	900ft.	15/–	

600 mW SOLID STATE

4-TRANSISTOR AMPLIFIER

Features NPN and PNP Complementary Symmetrical Output Stage. The elimination of transformers ensures maximum efficiency and frequency response. Automatic heat compensation. Combined A.C./D.C. feedback. Class B output stage, i.e. output power is proportional to total current consumption, this ensures long battery life. Under no signal condition (IQ) current drain is approx. 12 mA at 9 volts (4 mA in the output pair). Printed circuit construction. Size: 2¼×⅞×⅞in. Speaker output impedance 12 ohms. Output power 600 mW at 5% distortion, 400 mW at 2.5% distortion, 750 mW at 10% distortion. Supply 9 volts. Total current consumption at a reasonable listening level approx. 35-40 mA at full power (speech and music) average 65 mA. Sensitivity for 50 mW output is 10 mW. Frequency response —3dB points 90 c/s. and 12 kc/s. **Price 15/-** plus 1/- P. & P.

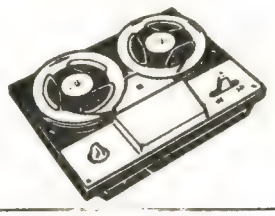
GEC DOORBELL

Complete with mains transformer, 240 v. A.C., and bell push. **Price 12/6** plus 5/6 P. & P.

BSR Tape Deck

SPECIAL PRICE **£5.19.6** Post and packing 7/6.

A.C. 200/250 v. taped speed 3¾ twin track.

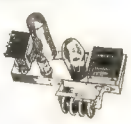


EXTRACTOR FAN

A.C. mains 230/250 v., complete with pull switch. Size 6×6×4in. **Price 27/6**, plus 5/- P. & P.

3 TO 4 WATT AMPLIFIER

3-4 watt Amplifier, built and tested. Chassis size 7×3¼×1in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6V6, £2/5/- plus 5/6 P. & P. The above in Kit Form, £1/14/6 plus 5/6 P. & P.



323 EDGWARE ROAD, LONDON, W.2.

PERSONAL SHOPPERS ONLY.

All orders by post must be sent to our Acton address. Early closing Thurs

NEW ★ LOW COST ★ HIGH QUALITY ★ ALL SILICON PLANAR TRANSISTORISED AUDIO KITS

Silicon transistors fabricated by Planar techniques are characterised by low leakage, low noise and high stability of parameters.

The low noise performance obtained by operating the transistors at extremely low collector currents is of particular interest to high fidelity enthusiasts.

The use of Planar devices in audio equipment has a number of other advantages and these are:

★Very low distortion figures can be obtained since the current gain does not vary appreciably with collector current.

★The low leakage currents of Planar transistors make it possible to design simple biasing circuits of high stability; changes in operating point due to leakage current are so small that they can usually be neglected.

★Transistors manufactured by epitaxial techniques have very low saturation voltages and high collector breakdown voltages, consequently, distortion can be kept low and the early stages of the equipment can tolerate large overload signals.

★PRE-AMPLIFIERS
P.A.20
★8 transistor with Zener diode decoupling.
★Rumble filter.
★6 inputs.
★Equalisation ±1 dB. of B.S.
★<0.1% total harmonic distortion.
<0.3% for 10: 1 input overload.
★Signal to noise 60dB.
★Bass +12dB to −15dB at 30 c/s.
★Treble +12dB to −12dB at 15 kc/s.

KIT £10/12/-. BUILT £14/5/6. P.P. 3/-.

15W R.M.S. AMPLIFIER
★7 transistors with 2 diodes.
★Stabilised bias for drivers to eliminate crossover distortion.
★Sensitivity 20 m/v R.M.S. for rated output.
★Total harmonic distortion <0·25% (1Kc)
★Freq. response with 1dB (20 c/s-20K/s)

KIT £8/15/-. BUILT £10/10/-. P.P. 3/-.
7W AMP.: To same circuit and spec.
KIT £7/16/6. BUILT £9/11/6. P.P. 3/-.

P.A.30
★3 transistor: 2 diodes
★5 inputs.
★<0.1% harmonic distortion.
★Signal to noise 60dB.
★Bass +15dB to −15dB at 30c/s.
★Treble ±15dB at 15 k/c.
KIT £8/2/-
BUILT £10/2/0
P.P. 3/-.

30W R.M.S. AMP.
★9 transistors. 4 diodes.
★100 Kc/s multivibrator circuit to eliminate crossover distortion.
★Sensitivity 20 m/v.
★Total Harm:dis: <0.4% (1K/c)
★Freq. resp.: within 1dB (20 c/s-20 kc/s)
KIT £14/5/-
BUILT £16/5/-
P.P. 3/-.

All kits are supplied with first class components including fibreglass P.C.B. Ferranti devices are used and the circuits are to their specifications. Further details and information for power supplies and tape kits are available on application.

WELBROOK ENG. & ELECTRONICS LTD.
BROOKS STREET, STOCKPORT. Tel. STO 4268

VALVES SAME DAY SERVICE
NEW! TESTED! GUARANTEED!

SETS 1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94. Set of 4 for **10/9.** DAF96, DF96, DK96, DL96, 4 for **24/-.**

1A7GT	7/6	7Y4	6/6	DH81	12/6	EF183	6/6	PCL85	8/3	UCH42	8/9
1H5GT	7/3	10F1	9/9	DK32	7/9	EF184	5/9	PCL86	8/6	UCH81	6/-
1N5GT	7/9	10P13	8/6	DK91	5/6	EH90	6/6	PENA4	6/9	UCL82	7/-
1R5	5/6	12AT7	3/9	DK92	8/-	EL33	6/6	PEN36C	15/-	UCL83	8/9
1S4	4/9	12AU6	4/9	DK96	6/6	EL41	8/6	PFL200	13/6	UF41	8/-
1S5	3/9	12AU7	4/9	DL33	6/9	EL42	7/9	PL36	9/-	UF80	7/-
1T4	2/9	12AX7	4/9	DL35	5/-	EL84	4/9	PL81	8/9	UF89	5/9
3A5	7/-	12K8GT	7/9	DL92	4/9	EL90	5/-	PL82	6/6	UL41	8/9
3Q4	5/6	20F2	10/6	DL94	5/6	EL95	5/-	PL83	6/3	UL44	20/-
3S4	4/9	20L1	14/-	DL96	6/-	EM80	5/9	PL84	6/3	UL84	6/-
3V4	5/6	20P1	9/-	DY86	5/9	EM81	6/9	PL500	13/6	UY21	8/9
5U4G	4/6	20P3	12/-	DY87	5/9	EM84	6/3	PX25	7/9	UY41	5/6
5V4G	7/9	20P4	15/-	EABC80	6/-	EM87	6/6	PY32	8/6	UY85	4/9
5Y3GT	5/-	25U4GT	11/6	EAF42	8/6	EV51	6/3	PY33	8/6	VP4B	10/6
5Z4G	7/9	30C15	10/6	EB91	2/3	EY86	6/-	PY80	5/3	VP1321	2/-
6/30L2	9/9	30C17	11/6	EBC33	7/-	EZ40	6/9	PY81	5/3	W77	3/3
6AL5	2/3	30C18	10/3	EBC41	8/-	EZ41	6/9	PY82	5/-	Z77	3/6
6AM6	3/6	30F5	9/9	EBF80	6/-	EZ80	4/6	PY83	5/9	**Transistors**	
6AQ5	4/9	30FL1	10/9	EBF89	5/9	EZ81	4/6	PY88	7/3	AC107	10/-
6AT6	4/-	30FL14	11/3	ECC81	3/9	GZ32	9/-	PY800	6/-	AC127	6/-
6BA6	4/3	30L15	11/-	ECC82	4/9	KT61	6/6	PY801	6/-	AD140	15/6
6BE6	4/3	30L17	12/-	ECC83	7/-	N18	5/6	R19	7/-	AF102	18/-
6BG6G	15/-	30P4	11/6	ECC84	6/3	N78	14/9	R20	12/9	AF115	6/-
6BJ6	6/9	30P12	9/9	ECC85	5/6	N108	13/6	U25	9/6	AF116	6/6
6BW6	7/3	30P19	11/6	ECF80	7/-	PC86	8/-	U26	9/6	AF117	5/-
6C86	6/6	30FL1	12/9	ECF82	6/9	PC88	8/-	U47	11/6	AF118	8/6
6F1	7/9	30FL13	13/3	ECF86	9/-	PC97	5/9	U49	11/6	AF124	7/6
6F13	5/6	30FL14	13/9	ECH35	6/-	PC900	7/9	U52	4/6	AF125	7/6
6F14	9/-	35L6GT	6/3	ECH42	9/-	PCC84	5/6	U78	3/6	AF126	7/-
6F23	9/9	35W4	4/6	ECH81	5/3	PCC89	9/9	U191	10/-	AF127	7/-
6K7G	1/6	35Z4GT	4/6	ECH84	6/6	PCC189	8/6	U301	11/9	OC22	9/9
6K8G	4/3	6063	12/6	ECL80	6/-	PCF80	6/6	U801	16/3	OC25	9/6
6K8GT	7/6	AZ31	9/-	ECL82	6/3	PCF82	6/-	UABC80	5/9	OC26	6/9
6L18	6/-	B36	9/6	ECL86	7/9	PCF86	8/3	UAF42	7/9	OC44	3/9
6V6G	3/6	B729	10/-	EF39	3/9	PCF800	10/6	UB41	6/6	OC45	3/3
6V6GT	6/6	DAC32	7/3	EF41	8/6	PCF801	8/9	UBC41	6/9	OC71	3/6
6X4	3/6	DAF91	3/9	EF80	4/9	PCF802	9/6	UBF80	6/-	OC72	4/9
6X5GT	5/9	DAF96	6/-	EF85	5/-	PCF805	9/9	UBF89	5/9	OC75	5/9
7B6	10/9	DCC90	7/-	EF86	6/3	PCF806	11/6	UBL21	9/-	OC81	3/6
7B7	7/-	DF33	7/9	EF89	5/-	PCF808	11/3	UC92	5/-	OC81D	3/6
7C5	9/6	DF91	2/9	EF91	3/6	PCL82	6/9	UCC84	7/9	OC82	5/9
7C6	6/9	DF96	6/-	EF92	3/3	PCL83	8/6	UCC85	6/6	OC82D	5/-
7H7	5/6	DH77	4/-	EF97	7/6	PCL84	7/-	UCF80	8/3	OC170	5/-

READERS RADIO
85 Torquay Gardens, Redbridge, Ilford, Essex. 01-550 7441

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

SALE OF VALVES
Unrepeatable after Stocks Cleared

1/- ea. ARP35; **1/6** ea. CC3L, EB34, 6B8G, 7475, 1F2; **2/6** ea. DF92, EC31, EY91; **3/-** ea. DL93, E2124, EC70, EF70, EL32, F6063, 2X2A, 6F32, 6J5G, 6J6, 6K7G, 6K8G; **3/6** ea. DAF91, DL92; **4/-** ea. AC/P4, DL73, DM70, E2221, EL35, OD3, S6F17, TT11, VR150/30, 1N21B, 2D21, 5A/173G, 6X5G, 6X5GT; **5/-** ea. DF96, EBC33, EN91, FVD7, HL133DD, KT55, L63, M8079, ME41, ML4, OA2, OB2, PY31, PZ30, R17, UBC41, V2053, VU71, VU/33A, Z66, 1D13, 1H5G, 2B35, 5U4G, 6AG7, 6AK7, 6AS6, 6BW6, 6CH6, 6K6, 6K6GT/G, 6K7, 6K8, 6L6G, 6N7G, 6SA7, 6SG7, 6SL7, 11E2, 85A2, 95A1, 354V, 6057; **6/-** ea. E2134, EL36, EL41, GZ30, GZ37, 5726; **7/6** ea. MX108, QVO4-7, 807, 1834; **10/-** ea. EM34, M8142, S130P, TD1-100A, VX3193, VX9192, XB1, 75C1, 150B2; **12/6** ea. EL37, EL38, G180/2M, 6B4G; **15/-** ea., A1834, ECC34, 6CD6G, 12E1; **20/-** ea. 85A1, Z759; **30/-** ea. 5B/254M, 5B/255M; **50/-** VX5029; **60/-** 4X150A; add 1/6 per order P. & P.

8-WATT MONO MAINS PUSH-PULL OUTPUT AMPLIFIER
EZ 80, ECC83, 2-EL84. Bass, treble, vol./on-off. **£5/15/-** (7/6 post).

TESTED AND ASSEMBLED I.F. TRANSISTORISED STRIP
3 IFS (Double Tuned), Osc., Diode, 3-AF117. P.C. Board 4½in.×2½in. 470 KHZ **25/-.** Plus post 2/6. With circuit diagram.

9-12 VOLT TRANSISTOR AMPS
(1) 200 mW. for 3-ohm speaker **30/-;** (2) 350 mW with switch vol. control for 3-ohm speaker **40/-;** (3) 1W. for 8- or 15-ohm speaker, **52/6;** (4) 3W for 8- or 15-ohm speaker **67/6.** (2/6 P. & P. EACH TYPE).

3-WATT AMPLIFIER
6in×4in×4½in Metal Rect. 6AM6 and EL84. Mains and O.P. Trans. For 3-ohm speaker. Tone, Vol. and On-off. **67/6** (6/- P. & P.).

2×4 WATT STEREO AMP. PRINTED CIRCUIT. SEPARATE POWER PACK
Metal Rect. ECC83 and 2-EL84. Neg. feedback. Vol. Bass & Treble each Channel. Muting switch; on/off. **£5/10/-** (7/6 P. & P.).

COPPER CLAD BOARD
(A) 8in.×8½in.×$\frac{1}{16}$in. **3/-** (post 2/- any qty.). (B) 7½in.×14½in.×$\frac{1}{16}$in. **5/-** (Post 2/6 any qty.).

6-TRANSISTOR "SUPER SIX" M.W. AND L.W. KIT
£4 (5/- post). Wooden Cabinet 11in.×7½in.×3½in. All parts may be purchased separately. 3½in. 10,000 line speaker. Or 7in.×4in. 6,000 line.

Send 6d. for 20-page illustrated catalogue.

GLADSTONE RADIO
66 ELMS ROAD, ALDERSHOT, HANTS. Aldershot 22240. (1 min. from station and buses. Closed Wednesday afternoon.)

SPECIAL BARGAINS

50 OHM 50 WATT WIRE WOUND POT-METER 8/6 each.
20K WIRE WOUND POT-METER. 20 watt type made by Colvern complete with control knob. **10/-** each.
1 MEG MINIATURE. Pot-meter Morganite standard. ¼in. spindle **1/-** each, 9/- per dozen.
1 MEG MINIATURE. Pot-meter Morganite preset screwdriver control. **9d.** each. 8/- per dozen.
PRE-SET 100K by Welwyn with intrical bakelite knob, **1/-** each. 9/- per dozen.
100K POT-METER. Miniature type with double pole switch and standard ¼in. spindle, by Morganite. **2/-** each. 18/- per dozen.
25K POT-METER. Standard size with double pole switch by Egan with full length ¼in. spindle. **3/-** each. 33/- per dozen.
BLANKETSTAT GLASS. Enclosed, normally closed circuit, will open should blanket overheat. **4/6** each.
THERMAL RELAY. Can be used to delay the supply of HT while heaters warm up, or will enable 15 amp. loads to be controlled by miniature switches or relays. Regular list price over £2, price **7/6** each.
SIEMENS HIGH SPEED RELAY. Twin 1000 ohm coils. Platinum points changeover contacts—Ex equipment. **8/6** each.
FOOTSWITCH. Two snap-action switches in metal box with flex lead. Ideal to control tape-recorder, dark room lamps, etc., **18/6** each, plus 2/9 postage and insurance.
TOGGLE SWITCH BARGAIN. 10 amp. 250 v. normal one hole fitting. **2/9** each, or 30/- per dozen.
ELECTRIC LOCK. 24 v. coil, but rewindable to other voltages, **4/6** each.
COMPRESSION TRIMMERS. Twin 100 pF. **1/-** each. 9/- per dozen.
MINIATURE RELAY. American make. 630 ohm coil. 20/30 volt operation. 2 pole changeover. **3/-** each. 30/- per dozen.
PRECISION WHEATSTONE BRIDGE. Opportunity to build cheaply. 100K wire wound pot. 15 w. rating, only **5/-**.
SHEET PAXOLIN. Ideal for transistor projects. 12 panels each 5in. × 8in. **5/-**.
8in. PM LOUDSPEAKER. 3 ohm. **12/6.** 80 ohm. **13/6.**
TRANSISTOR FERRITE SLAB AERIAL with medium and long wave coils. **7/6** each.
SLIDE SWITCH. Sub miniature double pole change-over. **2/-** each. 18/- per dozen.
Vacuum Cleaner Flex. Non-kinkable ribbed rubber, most pliable but very tough. 24/36 Cores. Normally 1/9 per yard, offered at **£3** per 100 yard coil, post and insurance 8/6.
Sub-Miniature Silicon Diodes. General purpose type with gold-plated, leads, **1/-** each, **10/6** per dozen.
MESSAGE TAPES. 150ft. Scotch Tape on 3in. spools, normally 4/6 each, we offer 4 tapes for **10/-**.
WHITE CIRCULAR FLEX. Ideal for lighting drops, twin made by BICC. Usually 8d. yd. 100 yd. coil for **30/-**, plus 6/- postage.
EDGEWISE CONTROL Morganite, as fitted many transistor radios, 2K or 5K with switch. **2/6** each or 24/- per dozen.
12V INVERTER. Full transistorised for operating a 20-watt fluorescent tube, size 6in. long × 1⅝ × 1⅝. **£3/10/-.** Post and insurance 3/-.
5 TRANSISTOR AMPLIFIER. Mounted on a printed board, size approx. 6 × 2½in. With volume control, input microphone socket and push-pull output using pair OC.81. An excellent amplifier rated at 1 watt. Price **£2/10/-.**

FIELD TELEPHONE UNIT

Each unit contains magneto type ringer and bell—as well as transformer—relay and switches. A pair of these with suitable hand-telephones (not supplied) will give two-way communication over distances of up to 5 miles. Unused but in stored condition. **19/6**, plus 10/6 carriage.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA. (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor. 5,000 and 500 mfd. condensers. Zener diode and instructions. Real snip at only **14/6**, plus 3/6 postage.

FLUORESCENT CONTROL KITS

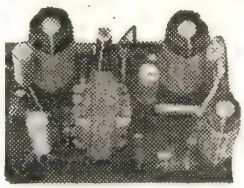
Each kit comprises **seven** items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes (for fish tanks and indoor plants). Chokes are super-silent, mostly resin filled. Kit A.—15-20 w. **19/6.** Kit B—30-40 w. **17/6.** Kit C—80 w. **17/6.** Kit D—125 w. **22/-.** Kit E—65 w. **19/6.** Kit MFI is for 6in., 9in. and 12in. miniature tubes—**19/6.** Postage on Kits A & B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D & E 4/6 on first kit then 3/6 for each kit ordered. Kit MFI 3/6 on first kit then 3/6 on each two kits ordered.

QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **19/6** post and insurance 1/6.

NO SOLDERING POCKET 3

Lots of fun to build and good results when finished complete kit with detailed instructions and crystal earpiece batteries, 1/2d. extra—**£5** value only **19/6**, plus 3/- dost & ins.



750mW TRANSISTOR AMPLIFIER

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up feed-back loops—sensitivity 5mV. Price **19/6.** Post and insurance 2/6. Speakers. 3in. **12/6,** 5in. **13/6.** 6 × 4in. **14/6.**

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to max. Full power at all speeds by fingertip control. Kit includes all parts, case, everything and full instructions. **19/6,** plus 2/6 post and insurance.
Available ready made **32/6.**

G.E.C. 13 amp. SWITCHED SOCKETS

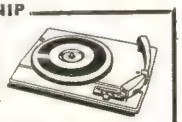
An excellent opportunity to re-equip your house or workshop, or if you are a contractor to restock for future ring main jobs. We offer 12 GEC switch sockets, Bakelite surface mounting choice. Latest ring main type listed at **6/6** each. You can have a box of 12 for **30/-** only—thus showing you a saving of **£2/8/-.** Postage and insurance 4/6 extra.

CASSETTE LOADED DICTATING MACHINE

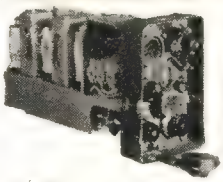
Battery operated and with all accessories. Really fantastic offer a British made **£31** outfit for only **£6/19/6** brilliantly designed for speed and efficiency—cassette takes normal spools drops in and out for easy loading—all normal functions—accessories include stethoscopic earpiece—crystal microphone has on/off switch telephone pick-up—tape reference pad—DON'T MISS THIS UNREPEATABLE OFFER—SEND TODAY. **£6/19/6** plus 7/6 post and insurance. Footswitch **18/6** extra. Spare Cassettes at **7/6** each, three for **£1.**

THIS MONTH'S SNIP

G.U.7 RECORD PLAYER



B.S.R. Record Player for normal mains operation. This is the famous B.S.R. Model GU7. Four speeds with automatic stop. Plays any size of record and is complete with crystal cartridge and sapphire stylus. Special snip price this month—**67/6** plus postage and insurance 6/6.



EX-WD BARGAIN Easily rebuildable to short wave radio

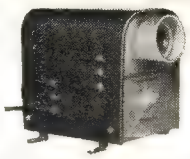
This is the 46 Receiver/Transmitter. It has a range of approx. 5 miles. Operates from dry batteries. Complete with six valves and in metal case. Size approx. 12in. × 6in. × 3½in. Complete but less crystal, not tested nor guaranteed. **19/6** plus 4/6 post and insurance. Should not be operated as a transmitter in the U.K.

PP3 Eliminator play your pocket radio from the mains: Save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions. **Only 6/6,** plus 1/- post.

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control **10/-** post free.

PHOTO ELECTRIC CONTROL SYSTEM

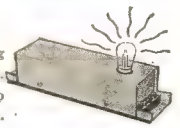


Comprises a light source unit with optional Infra Red filter and lens system to focus the light. Also a photo-electric Relay control unit. Both are housed in metal cases for bench or wall mounting and there is a sensitivity control as well as mains on-off switch. The outfit works from 230/240 A.C. Mains. Can be used as a simple on-off switch by breaking the beam of light (invisible if Infra Red filter is used) and as such it will operate as a burglar alarm, or will open doors, etc. Also in conjunction with a counter or other equipment it will perform many functions in the factory or warehouse. Price **£9/19/6,** plus postage and insurance 8/-.

SOLID STATE IGNITION

Big things are claimed of Electronic ignition systems and if you would like to try for yourself a circuit was described in *Practical Electronics* (Sept., 1966) This requires a silicon controlled rectifier, four transistors and other components available as a kit. Price **£6/15/-,** post free.

OZONE AIR CONDITIONER



For removing smells and generally improving oppressive atmosphere. In neat hammer finish box. Uses Philips ozone lamp and mains unit. Lamp easily replaceable. Only **39/6** plus 6/6 carr. and ins.

THERMOSTATS

Type "A" 15 amp. for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob quickly adjustable from 30-80° F., **9/6,** plus 1/- post. Suitable box for wall mounting, **5/-.** F. & P. 1/-.
Type "B" 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50-550° F. Internal screw alters the setting so this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven kiln, immersion heater or to make flame-start or fire alarm. **8/6,** plus 2/6 post and insurance.
Type "D" We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses, one of which would be to keep the loft pipes from freezing. If a length of our blanket wire (16 yds. **10/-**) is wound round the pipes, **7/6.** P. & P. 1/1.
Type "E." This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperatures. **7/6,** plus 1/- post.
Type "F." Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price **18/-,** plus 2/- post and insurance.

SATCHWELL OVEN THERMOSTAT

Type **TO.** With capilliary tube and sensor. 20 amp. A.C. type and as fitted to many cookers. Adjustable by control knob (not supplied) **12/6** each.

SIMMERSTAT HEATER REGULATOR

Suitable to control elements, heater, soldering irons and boiling rings up to 2,500 watts. Completely adjustable, normal price **55/-** each. Special Snip. Price **12/6,** plus 2/- post and ins.

HI-FI SPEAKER BARGAIN

12in. High fidelity loudspeaker. High flux permanent magnet type with either 3 or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price **29/6.** With built-in tweeter **35/-,** plus 3/6 post and insurance.

COSMOCORD PICK-UP FOR 7in. RECORDS

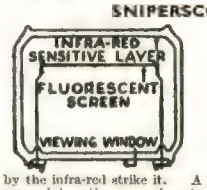
Grey plastic arm fitted with GP79/5 mono ceramic cartridge and replaceable stylus. Ref. S79. Freq. response 50-8,000 cps., 250 mv. output. Tracking wt. 9 gms. Offered at **5/-,** plus 1/- P. & P.

11 RANGE TESTMETER

For checking car electrics, radio, TV, ignition systems, household lighting etc. Measures AC/DC volts, D.C. current, Resistance. Will last a lifetime.

39/6 P. & P. 3/6.

SNIPERSCOPE



Famous war-time "cat's eye" used for seeing in the dark this is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. A golden opportunity for some interesting experiments, **7/6** each, post 2/6. Data will be supplied with cells, if requested.

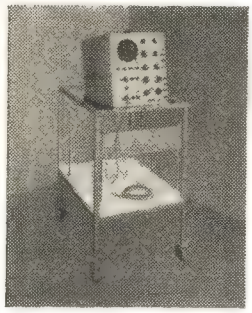
PRINCESS SUPERHET

Only recently sold for **£10/9/9.** Note these features: ● Long & Medium Wave ● Long dial ● Push pull output ● A.V.C. and feed back ● Ferrite aerial ● Six transistors ● Cabinet size 4½in. × 3in. × 1½in. with carrying strap. You get everything you need and instructions. **39/6** plus 3/6 P. & P. or **supplied with made up chassis 10/- extra.** Battery 1/9 extra. Data separately 2/6.

Where postage is not definitely stated as an extra then orders over **£3** are post free. Below **£3** add 2/9. Semi-conductors add 1/- post. Over **£1** post free.

ELECTRONICS (CROYDON) LIMITED

(Dept. WW), 102/3 TAMWORTH RD., CROYDON, SURREY *(Opp. W. Croydon Stn.)*
also at **266 LONDON ROAD, CROYDON, SURREY.**



AVONCEL EQUIPMENT TROLLEYS

Medium Duty from £17. Heavy Duty from £35. Wide range of Standard Models. Quick Delivery. Special Models made to order.

"AVONCEL"

AVON COMMUNICATIONS & ELECTRONICS LTD
318 BOURNEMOUTH (HURN) AIRPORT
CHRISTCHURCH, HANTS. Tel. NORTHBOURNE 3774 (P.B.X.)

WW—134 FOR FURTHER DETAILS

Introduction to Laplace Transforms
for radio and electronic engineers

W. D. Day, A.M.I.E.E., A.M.I.E.R.E.

Presents the theory of the Laplace transformation in easily understood language, dealing with electrical circuits from the very first paragraph to the stage when transforms are used to investigate transient conditions. The first part of the book is designed for home study while the second half is designed as an introduction to more advanced texts.

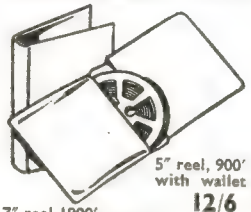
32s 6d net, by post 33s 7d

from leading booksellers

ILIFFE Books Ltd
DORSET HOUSE, STAMFORD STREET, LONDON, SE1

BARGAIN OPPORTUNITIES FROM TRS

EXCLUSIVE T.R.S. TAPE OFFER
FREE LIBRARY WALLET WITH EVERY REEL



With each reel of this tape by an internationally famous manufacturer we give you a beautifully made wallet strongly made in simulated leather with space for a reel of tape each side. This is professional quality full frequency tape with metallised leader/stop foils. These library wallets solve once and for all the problems of storing tapes efficiently and tidily.

5" reel, 900' with wallet 5¾" reel, 1200' or 7" reel, 1200' with wallet **12/6** **17/6**
7" reel 1800' with wallet. **22/6**
p. & p. 1/6 per reel

TAPE REELS
7"-2/3; 5¾"-2/-; 5"-2/-; 3"-1/3

TAPE AMPLIFIER
WITH 4 VALVES, FRONT PANEL, WIRED & TESTED **£6.5.0**

OUTSTANDING T.R.S. VALUE—Absolutely complete, mains powered amplifier for B.S.R. T.D.2 Deck. Supplied wired and tested. Facilities include mike/radio/P.U. inputs, playback switching, superimpose, magic eye, tone and volume controls, 3Ω outlet and monitoring. With front panel and knobs. **£6/5/-.** (P. & P. 5/-).

Contemporary styled 2-tone cabinet to take above. Size 14 x 13¼ x 7¼in. *Detachable lid.* **39/6** (P. & P. 7/6)

T.R.S. MULLARD STEREO 10-10

Valve amplifier by T.R.S. to exact Mullard spec. Complete with pre-amp and o/p transformers tapped for 3 and 15 Ω. Bass, treble, volume, balance controls. Outlet for H.T. and L.T. for tuner. Switching for mono/stereo and speaker phasing. Shrouded pre-amp. Complete with plugs, sockets, escutcheon, knobs, etc.

£19.10.0 (C/P 12/6) At present supplied wired and tested. Kit version available very shortly at **£17/10/-.** (C/P 12/6).

T.R.S. MULLARD 3-3
3 valve, 3 watt amp., complete kit **£7/10/-** (Carr. 7/6).

T.R.S. MULLARD 5-10
Basic amplifier kit complete **9½ gns.** With passive control network and panel **£11/19/6.** (Carr. 7/6) PRE-AMP KIT **£6/12/6** (Carr. 5/6).

7 VALVE AM/FM RG CHASSIS

A superbly powerful high performance instrument for the keenest enthusiasts. Provides tuning on long, medium and F.M. wavebands. 3 wave-band L/M/FM Permeability tuning on F.M. Large clear dia A.V.C., good neg. feedback. Magic eye. 3 w. output. A.C. 200/250 v. Circuit diagrams available. Aligned, tested and ready for use (Carr. and ins. 7/6). S.A.E. brings full details. **£13.19.6**

VOLUME CONTROLS. LOG and LINEAR. We carry very large stocks in the widest possible range of values, single and ganged. 5K-2MΩ. 3in. spindles. Morganite Midget Type 1½in. diam. Guar. 1 year. LOG or LIN ratios less Sw., **3/6.** D.P. Sw. **5/-.** Twin Stereo less Sw. **7/6.** D.P. Sw. **9/6** (100K to 2 Meg. only).
STEREO BALANCE CONTROLS. Log/Anti-Log 5KΩ. ½, 1, 2 Meg. **9/-** each.
TYGAN FRET spkr. fabric, 12 x 12in. **2/-**; 12 x 18in. **3/-**; 12 x 24in. **4/-**, etc.
BONDACOUST Speaker Cabinet Acoustic Wadding, approx. 1in. thick, 18in wde, any length cut, **2/3** ft. **6/-** yd.
EXPANDED ANODIZED METAL. Attractive gilt finish ½ x ½in. diamond mesh **4/6** sq. ft. Multiples of 6in. cut. Max. size 4 x 3ft. **47/6** plus carr.
VEROBOARD—All standard sizes including 2½in. x 5in. **3/8**; 2½in. x 3¾in. **3/-**; 3¾ x 5in. **5/2**; 3¾ x 9½in. **3/8**; 2½ x 17½in. **12/6.** All accessories and tools in stock.
PRE-SET WIRE WOUND POTS (T/V type). 25-30Ω **3/3**; 50Ω **4/6**; Carbon track, 50K-2 Meg., **3/3.**

WE ARE APPOINTED STOCKISTS FOR ALL SINCLAIR AND PEAK SOUND PRODUCTS

OUR LATEST LIST is brimful of bargains and hard-to-find components. Send 6d stamp for free copy.

RESISTORS—Modern ratings, full range 10 ohms to 10 megohms, 10% ½-1 w. **4d.** ea. 5% Hi-Stab., ½-1 w. **6d.** ea. (below 100 ohms and over 1 meg. **9d.** ea.). 1% Hi-Stab, ½ w. **1/6d.** ea. (below 100 ohms **2/-** ea.).
WIREWOUND RESISTORS. 25 ohms to 10 K. 5 w. **1/3**; 10 w. **1/6**; 15 w. **2/-.**
CONDENSERS Silver Mica. All values 2 pf. to 1,000 pf **6d. ea. Ditto ceramics 9d. Tub. 450 v. T.C.C., etc. .001 mfd. to 0.1 mf./350 v. 10d. .02 mf. to 0.1 mfd. 500 v. 1/-. .25 T.C.C. 1/9. 5 T.C.C. 2/-. CLOSE TOL. S/MICAS.** 10% 5 pf-500 pf **8d.** 600-5,000 pf **1/-.** 1% 2 pf.-100 pf. **9d.** 100 pf. **9d.** 100 pf., 500 pf. **11d.** 378 pf. 5,000 pf. **1/6.**
ALUM. CHASSIS. 18 g. Plain undrilled, folded 4 sides, 2in. deep. 6 x 4in. **4/6**; 8 x 6in. **5/9**; 10 x 7in. **6/9**; 12 x 6in. **7/6**; 12 x 8in., **8/-** etc.

ALWAYS IN STOCK AT KEENEST PRICES. Transistors, Coils, Switches, Valves, Speakers, Materials. See latest T.R.S. lists. *Please send S.A.E. with your enquiries*

GARRARD UNITS & PLINTHS

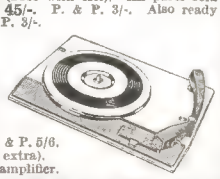
LM.3000. Autochanger with 9TA stereo cartridge. **8 gns.**
AT60 Mk. II AUTOCHANGER DE LUXE. With 12in. cast turntable, less cartridge. **£10.19.6**
SP.25 DE LUXE. Single playing unit. Less cartridge. *Carr. and packing on any of above* 7/6. **9½ gns.**
GARRARD PLINTH. Suitable for use with any of the units here. With soft plastic dust cover (Car. and pack.5/-). **£3.15.0**
CLEARVIEW rigid perspex cover (p/p 3/6) **57/6**
GARRARD CARTRIDGES. All types available. Post free from Mono at **15/-** to Stereo from **25/-**
We stock Sapphire and Diamond Styli for most pick-ups at attractive prices.

TRS RADIO COMPONENT SPECIALISTS
Established 1946
70 BRIGSTOCK ROAD, THORNTON HEATH, SURREY
Tel.: 01-684 2188. Hours 9 a.m.—6 p.m. 1 p.m. Wednesdays
A few doors from Thornton Heath Stn. (S.R. Victoria section).

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1

● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size driver and output transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET 114 or S1 Mullard OC81D and matched pair of OC81, o/p). ● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 2/6 (Free with Kit). All parts sold separately. **SPECIAL PRICE 45/-.** P. & P. 3/-. Also ready built and tested **52/6.** P. & P. 3/-.

SPECIAL PURCHASE. B.S.R. GU7



9 volt Battery Operated Record Player Units. 4 speeds, Automatic stop. Plays any size record. Complete with mono t/o head and sapphire styli. **ONLY 69/6.** P. & P. 5/6. (With stereo cartridge **12/6** extra). Ideal for use with the above amplifier.

HSL "FOUR" AMPLIFIER KIT

3-VALVE, 4 WATT USING ECC83, EL84, EZ80 VALVES for A.C. mains 200/240v. ★ Heavy duty double-wound mains transformer with electrostatic screen. ★ Separate bass, treble and volume controls, giving fully variable boost and cut with minimum insertion loss. ★ Heavy negative feedback loop over 2 stages ensure high output at excellent quality with very low distortion factor. ★ Suitable for use with guitar, microphone or record player. ★ Provision for remote mounting of controls or direct on chassis. ★ All this builds on to a chassis size only 7¼in. wide x 4in. deep. Overall height 4¼in. ★ All components and valves are brand new. ★ Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success. ★ Supplied complete with valves, output transformer (3 ohms only), screened lead, wire, nuts, bolts, solder, etc. (No extras to buy.) **PRICE 79/6.** P. & P. 6/-. Comprehensive circuit diagram, practical layout and parts list 2/6 (free with kit).
TV U.H.F. TUNER AND SOUND AND VISION I.F. PANEL By world famous maker. Suitable for use in conversion of TV sets to BBC2 (625 line reception). OFFERED (less valves) AT THE BARGAIN PRICE OF **ONLY 27/6.** Post paid. (We regret that no correspondence can be entered into on this item).

4-SPEED PLAYER UNIT BARGAINS

Mains Models. All brand new in maker's original packing.
SINGLE PLAYERS. Carr. 5/6 on each.
B.S.R. TU/12 **£3/9/6.** Garrard SP25 de luxe .. **£10 19 6**
B.S.R. GU7 with unit mounted pick-up arm **£4 18 8**
AUTO. CHANGERS. Carr. 6/6 on each.
B.S.R.U A25 Super slim **£6 2 6** GARRARD 2000 **£7 10 0**
GARRARD 3000 **£8 15 0** GARRARD 1000 with HiFi cartridge **£6 19 6.** Latest GARRARD AT60 Mk. II **£12 0 0**
All the above units are complete with t/o mono head with sapphire styli or can be supplied with stereo head at **12/6** extra.

QUALITY RECORD PLAYER AMPLIFIER, MK. II

A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves, separate bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w x 3in. d. x 6in. h. Ready built and tested. **PRICE 69/6.** P. & P. 6/-. ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet on right. **PRICE 89/6.** P. & P. 7/6.

DE LUXE QUALITY PORTABLE R/P CABINET

Uncut motor board size 14½in. x 12in., clearance 2in. below, 5½in. above. Will take amplifier above and any B.S.R. or GARRARD Autochanger or single Player Unit (except AT60 or SP25.) Size 18in. x 15in. x 8in. **PRICE £3/9/6.** Carr. 9/6

HARVERSON SURPLUS CO. LTD.
170 HIGH ST., MERTON, LONDON, S.W.19 *Tel: 01-540 3985*
S.A.E. all enquiries. Open all day Saturday (Wednesday 1 p.m.)

MULTI-TAPPED TRANSFORMERS

MOST TYPES, FULLY SHROUDED AND TERMINAL BLOCK CONNECTIONS. ALL PRIMARIES 220-240 VOLTS

*Denotes Unshrouded Types.

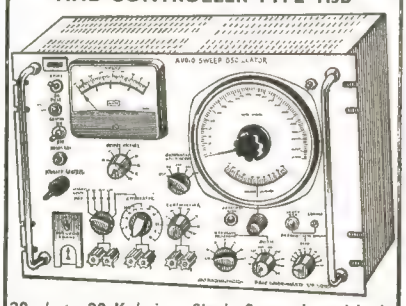
TYPE	SEC. TAPS	AMPS.	PRICE	CARR.
1A	25-33-40-50	15	£7 19 6	9/-
1B	25-33-40-50	10	£5 19 6	7/6
1C	25-33-40-50	6	£4 19 6	7/6
1D	25-33-40-50	3	£2 19 6	6/-
2A	4-16-24-32	12	£5 7 6	7/6
2B	4-16-24-32	8	£4 2 6	7/6
2C	4-16-24-32	4	£2 12 6	6/-
2D	4-16-24-32	2	£1 15 0	5/-
3A*	25-30-35	40	£12 15 0	15/-
3B*	25-30-35	20	£7 19 6	9/6
3C	25-30-35	10	£5 10 0	7/6
3D	25-30-35	5	£3 5 0	6/-
3E	25-30-35	2	£2 7 6	4/6
4A*	12-20-24	30	£9 15 0	10/-
4B	12-20-24	20	£5 19 6	8/6
4C	12-20-24	10	£3 19 6	7/6
4D	12-20-24	5	£2 15 0	6/-
5A	3-12-18	30	£7 5 0	7/6
5B	3-12-18	20	£5 9 6	7/6
5C	3-12-18	10	£3 5 0	6/-
5D	3-12-18	5	£2 5 0	5/-
6A	48-56-60	2	£2 17 6	4/6
6B	48-56-60	1	£1 19 6	4/6
7A*	6-12	50	£7 15 0	9/6
7B	6-12	20	£4 10 0	7/6
7C	6-12	10	£2 19 6	6/6
7D	6-12	5	£2 2 6	5/-
8A	12-24	1	19 6	4/-
9A	15-30	1½	19 6	4/6
10A	1-15	2	19 6	4/6
11A	6-3	15	£1 17 6	5/6

Note: By using the Intermediate Taps many other voltages can be obtained. Example:
Range One: 7-8-10-15-17-25-33-40-50 v.
Range Two: 4-8-12-16-20-24-32 v.
Range Five: 3-6-9-12-15-18 v.

Samson's Electronics Ltd.

9 & 10 CHAPEL STREET, LONDON, N.W.1
Tel. PAD 7851 AMB 5125

DAWE AUDIO SWEEP OSCILLATOR AND CONTROLLER TYPE 443B



20 c/s to 20 Kc/s in a Single Sweep Logarithmic Scale Calibration. Accuracy ±1% ±1 c/s. Power supply 110 v. and 200-250 v. Dimensions: 19×12×13ins. Supplied Brand New with Instruction Manual. Less than half Maker's Price. **£125,** Ex Warehouse. Send 6d. Stamp for Data Sheet.

DAWE AUTOMATIC L.F. SWEEP OSCILLATOR

Type 444C. 5 c/s to 5,000 c/s in a Single Range. 6-inch dia. dial with Logarithmic Calibration over 216° of Arc. Fre. Accuracy ±5%. Output continuously variable up to 10 v. R.M.S. into a minimum Load Resistance of 10KΩ. Monitored on a Panel Voltmeter Power Supply. 110 v. and 200-240 v. 50 c/s. Dimensions: 19×18×9ins. Supplied Brand new with Instruction Manual. Less than half Maker's Price. **£100.** Send 6d. Stamp for Data Sheet.

Send 6d. Stamp for our latest Component Price List.

SMITHS 1 R.P.M. GEARED MOTORS

A.C. 200-250 volts 2 watts. Overall size 2×2in. Length of spindle ¾in. **25/-.** P. & P. 2/-.
As above, but for 24 v. A.C. operation, **19/6.** P.P. 2/-.

WONDERFUL OFFER ! !

SCOTCH MAGNETIC TAPE. Type 3M 459. ¼in. 3,600 feet. Suitable for video. Brand new in maker's sealed cartons. List Price £18/10/-. Our Price **£3/19/6.** P.P. 5/-.

STABILISED L.T. SUPPLY UNITS

A.C. Input 220-240 v. D.C. Output 2 independent sections giving 24 volts 5 amps. Open unit built on Chassis. Size: 26×7ins. Brand new. Fraction of Maker's Price. **£25.** Ex Warehouse.

SPECIAL OFFER OF WODEN TRANSFORMERS BRAND NEW

No. 1. PRI tapped 200-250 v. E.S. Sec. Tapped 8-15-25-28-30-33-35 v. 15 amps. Tropically finished table top connects. **£5/17/6.** Carr. 10/-.
No. 2. PRI 240 v. E.S. Sec. No. 1. 50 v. 4 A. Sec. No. 2. 18-0-18 v. 1 A. **55/-.** P.P. 7/6.
No. 3. PRI tapped 200-250 v. E.S. Sec. 1. 315-0-315 v. 110 mA. Sec. 2. 175-0-175 25 mA. Sec. 3 5 v. 1.9 A. Sec. 4. 6.3 v. 3.1 A. Sec. 5. 6. 3. v. CT4A. Sec. 6.3 v. CT2A. Sec. 6.3 v. 1 A. "C" Core table top connections. **50/-.** P.P. 7/6.

SURPLUS L.T. TRANSFORMERS ALL BY FAMOUS MAKERS

A. Pri. 200-240 v. Sec. (1) Tapped 38 v., 40 v. 10A. Sec. (2), 6.2, 6.8, 7.3, 7.9, 8.5, 9, 9.5 10, 10.6 v. 18 amps. **£7/10/-.** Carr. 10/-.
B. Pri. 240 v. Sec. Tapped 53.6, 55.2 v. 6 amps. "C" core, **72/6.** Carr. 7/6.
C. Pri. 200-240 v. E.S. Sec. tapped 32, 34, 38, 40, 44, 46 v. 7 amps. **75/-.** Carr. 7/6.
D. Pri. 200-240 v. Sec. 8 v. 6 amps. **19/6.** P.P. 4/6.
E. Pri. 200-240 v. Sec. (1) 25 v. 3 A. Sec. (2) 10 v., 0.1 A. Sec. (3) 115 v. 0.6A., **29/6.** P.P. 4/6.
F. Pri. 240 v. Sec. (1) 45 v. 25 M/A.Sec. (2) 1 v. ½ amp. **15/-.** P.P. 3/6.
G. Pri. 200-250 v. Sec. 6.2 v. 12.5 amps. tropically rated, **25/-.** Carr. 7/6.

Jason KITS

★ TAPE ★

We offer you fully tensilised polyester/mylar and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more coppers than acetate, sub-standard, jointed or cheap imports. TRY ONE AND PROVE IT YOURSELF.

Standard		Long	
3in. 150ft.	2/3	3in. 225ft.	2/9
4in. 300ft.	4/6	4in. 450ft.	5/6
5in. 600ft.	7/6	5in. 900ft.	10/6
5½in. 900ft.	10/6	5½in. 1,200ft.	13/-
7in. 1,200ft.	12/6	7in. 1,800ft.	18/6

Double		Triple	
3in. 300ft.	4/-	4in. 900ft.	13/-
4in. 600ft.	8/-	5in. 1,800ft.	25/-
5in. 1,200ft.	15/-	5½in. 2,400ft.	34/-
5½ni. 1,800ft.	19/-	7in. 3,600ft.	44/-
7in. 2,400ft.	27/-	Quadruple	
Postage 1/- reel.		3in. 600ft.	8/6

Post Free less 5% on three reels.
Quality and Trade enquiries invited.
NOTE. *Large tape stocks at all branches.*

STEREO PORTABLE CABINETS

Latest black and silver metal finish. Consisting of centre cabinet size 16½in.×13in.×8in. deep with lift up lid together with two 10×6 speaker cabinets which clip on ends of main cabinet size 4½in.×13in.×8in. making overall siaze of 25½in.×13in.×8in. High quality chrome fittings. Will take almost any autochanger or tape deck. Approx. half price at **£3/19/-**
Ditto, but less chrome, takes 7×4 speaker **£2/19/9**
AUTOCHANGE PORTABLE CABINETS. As used on 18 gns. record player. Due to fortunate purchase we offer complete with motor board and all fittings at only **49/-**
PLEASE NOTE. *A wide range of cabinets to callers at all branches.*

100 HI-STABS 9/6
1% to 5% 100Ω to 5 mΩ.
CO-AX, low loss, **6d.** yd. 25 yds. **11/6,** 50 yds. **22/-;** 100 yds. **42/6.** Plus **1/3.**

100 RESISTORS 6/6
SIZES ¼-3 watt.
MICROPHONE CABLE. Highest quality, black, grey, white, **9d.** per yard.

100 CONDENSERS 9/6
Miniature Ceramic, Silver, Mica, etc. 3pF to 5μF. LIST VALUE OVER £4.

LATEST GARRARD

SRP12	£4.7.6
SP25	£9.19.0
AT.5	£5.10.0
Model 50	£7.10.0
Model 1,000	£6.5.0
Model 2,000	£8.10.0
Model 3,000	£8.10.0
AT60 Mk. II	£11.19.0
A70	£18.10.0
LAB 80 Mk. II	£24.19.0
401	£29.19.0
ER60 Stereo Ceramic	24/-

PLINTHS

Teak de luxe finish cut out for SP25, Model 5D, 1,000, 2,000, 3,000 AT60 ..... **59/-**
Ditto, super Perspex clear cover, complete **£5.15.0**
Lab 8D, 401, A70, Superb new hinged lid, teak and Perspex plinth (List £12.10.0) **£9.19.0**

BARGAIN PARCELS

Including variable condensers, i.f. coils, loud-speaker plugs/sockets, knobs, pots, condensers, resistors, nuts, bolts, cabinet fittings, switches, transformer choke, rectifier, transistors at a small fraction of list value. Due to heavy demand we are now packing them in several sizes—TRY ONE.
3 lbs. (post 3/-) **9/-**
7 lbs. (post 5/-) **17/6**
14 lbs. (post 6/-) **29/-**

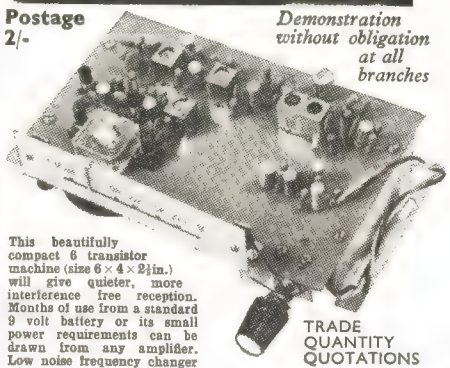
HEAVY DUTY 14/20 watt AMPLIFIER KITS

Famous make consisting integrated controls, high/low gain preamp stages feeding EL.34 Push Pull Output, C core transformers, complete with instructions down to the last bolt. Current model at fraction of list price. **8½ Gns.**

Transistorised FM Tuner

Postage 2/-

Demonstration without obligation at all branches



This beautifully compact 6 transistor machine (size 6×4×2½in.) will give quieter, more interference free reception. Months of use from a standard 9 volt battery or its small power requirements can be drawn from any amplifier. Low noise frequency changer with smooth 2 gang tuning feeding no less than three I.F. stages coupled to a double-tuned discriminator terminating in an L.P. stage giving ample output for all quality amplifiers.

HUGE DEMAND ENABLES PRICE REDUCTION

TRADE QUANTITY QUOTATIONS

Order now! £6-10

CALLERS. *A very wide range of electronic components await you at all branches. Your enquiries welcomed.*

TECHNICAL TRADING

All Mail Orders to Brighton please

SILICON H.T. RECTIFIERS

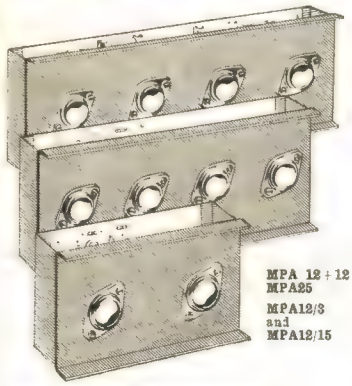
Guaranteed performance. Top makes. Tested 250 v. working. 120 mA (3 for 6/6) **2/9**
500 mA (3 for 19/6) **7/6**

★ **LONDON**—10 Tottenham Court Rd. Tel: MUS 2639
★ **PORTSMOUTH**—350-352 Fratton Rd. Tel: 22034
★ **SOUTHAMPTON**—72 East St. Tel: 25851
★ **WORTHING**—132 Montague St. Tel: 25851
★ **BRIGHTON**—Devonian Court, Park Crescent Place
All Mail Order (24-hour Robophone) Brighton 680722

FREE FLOG LIST No 2 Scores Special Bargains
SEND S.A.E. OR CALL AT ANY BRANCH FOR YOURS

G

NEW! SOLID STATE HIGH FIDELITY EQUIPMENT ★ ★ ★
MONO AND STEREO PREAMPLIFIERS, 12 AND 25 WATT AMPLIFIERS



MPA 12+12
MPA25
MPA12/3
and
MPA12/15

MP3 ◀

SP6-2 ▼

MP3. Mono Preamplifier. All silicon low noise zener stabilised circuit. Full range of controls—fully equalised inputs for Xtal PU Dynamic/Xtal Mic., Radio Tuners, Tape Head and Preamp Relay. Supplied built and tested, on metal chassis, complete with front Grey/Silver panel, Aluminium Knobs, and Handbrook. Output 250 mV. Supply 12 to 60 volts, 3 mA. Overall size 9¼ × 1⅜ × 1¼in. **MP3 Price £6.19.6** p.p. 3/-.

SP6-2. Mono/Stereo Preamplifier. Uses 8 Silicon/Germanium devices, Zener stabilised. Completely new low noise design. Full range of controls and filters. Inputs for Magnetic/Xtal/Ceramic Cartridges, Radio Tuners, Tape Preamp., microphones, Tape Head, etc. Record output socket. Supplied built and tested on metal chassis with Grey/Silver front panel and matching knobs. Complete with Input Sockets and Handbook. Output 250 mV per channel. Supply 12 to 60 volts 4 mA. Overall size 12 × 3⅛ × 3¼in. **SP6-2 Price £14.19.6** p.p. 5/-.

SP4. Mono/Stereo Preamplifier, as previously advertised. Complete with Front Panel and Knobs. Size 9 × 3¼ × 1⅜in. **SP4 Price £10.19.6** p.p. 3/6.

MPA12/3 and MPA12/15. 12 watt Power Amplifiers for use with above preamplifiers. Improved response and performance with even lower distortion levels. MPA12/3 for 3 to 5 ohm speakers, 24/28 volt supply. MPA12/15 for 10 to 16 ohm speakers, 40/45 volt supply, uses 8 silicon and germanium devices. Inputs 100 mV for 12 watts, response ±1 dB 30 c/s. to 20 kc/s. THD 0.2% at 12 watts. High gain stable push-pull output designs. Built on to metal chassis as illustrated. Overall size 5 × 2 × 3¼in. Complete with handbook.

MPA12/3 Price £4.10.0 p.p. 2/6. **MPA12/15 Price £5.5.0** p.p. 2/6.

MPA12+12. Twin Amplifier for Mono/Stereo use with above preamplifiers. Consists of two matched MPA12/15 amplifiers—see above—on single chassis. Output for 10 to 16 ohm speakers. 40/45 volt supply. Overall size 10 × 2 × 3¼in. **MPA12+12 Price £9.19.6** p.p. 4/-.

MPA25. 25/30 watt Power Amplifier for use with above preamplifiers. New design and layout with improved response and overall performance. Output for 7½ to 16 ohm speaker systems. Input 180 mV for full output. Push-pull circuit uses 10 silicon and germanium devices. Supply 50/60 volts. Overall size 8 × 2 × 3¼in. **MPA25 Price £7.10.0** p.p. 3/6.

NEW LOW NOISE DESIGNS
NEW COMPACT CONSTRUCTION
NEW PERFORMANCE SPECIFICATIONS
NEW CHOICE OF EQUIPMENT
NEW LOW PRICE STRUCTURES

RECOMMENDED COMPLETE SYSTEMS

MP3+MPA12/15+PS40 **£14/12/6.** P.P. 6/6
MP3+MPA12/3+PS24 **£13/17/6.** P.P. 6/6
MP3+MPA25+MU60 **£18/5/-.** P.P. 8/-
SP6-2+(MPA12+12)+MU40 (or (2)-MA12/15) **£28/5/-.** P.P. 10/-
SP6-2+(2)MPA12/3+MU24 **£26/15/-.** P.P. 10/-
SP6-2+(2)MPA25+MU60 **£33/5/-.** P.P. 10/6
SP4+(2)MPA12/15+PS40 **£24.** P.P. 9/-
SP4+(2)MPA12/3+PS24 **£22/15/-.** P.P. 9/-
MP3+(2)MPA12/15+MU40 **£20/17/6.** P.P. 8/-
MP3+(2)MPA12/3+MU24 **£19/7/6.** P.P. 8/-

XP2. Preamp Module 4 mV 50Kohm Input for Mag. Pu., 50 K mic, Tape Head. **45/-.** P.& P. 1/6.
X54. Stereo Version. **70/-.** P.P. 1/6.

COMPLETE SYSTEMS FROM 12 WATT MONO UP TO 50/60 WATT MONO/STEREO.

MAINS UNITS
110/240 volt 40/60 c/s input, A.C./D.C. fused. Fully smoothed and isolated. Mu series has additional choke/capacitors filtering and panel voltage selectors. All types on metal chassis.
PS24/40. Output 24 and 45 volts 1 amp. for use with 1 or 2 MPA12/3, MPA12/15, or (1) MPA12+12. **Price 70/-.** P.P. 3/-.
MU24/40. Choke smoothed. Output 24 and 45 volts 1 amp. for use with 1 or 2 MPA12/3 and MPA12/15 or (1) MPA12+12. **Price 87/6.** P.P. 3/6
MU60. Choke smoothed. Output 50 volts 1 amp. for use with 1 or 2 MPA25. **Price 95/-.** P.P. 4/-.

THE FINEST VALUE IN HIGH FIDELITY—FULLY GUARANTEED.
CHOOSE A SYSTEM OR UNIT TO SUIT YOUR NEEDS.

COMPLETE BROCHURE FREE ON REQUEST

VHF FM TUNER TO BUILD LEAFLET ON REQUEST
87/105 Mc/s. Transistor Superhet. Geared tuning. Terrific quality and sensitivity. For valve or transistor amplifiers. 4 × 3½ × 2¼in. Complete with dial plate. 5 Mullard Transistors, plus 4 Diodes (Cabinet Assembly **20/-** extra). Decoder kit, **£5/19/6.** p.p. 2/-). **TOTAL COST TO BUILD £6.19.6** P.P. 2/6

AMPLIFIERS
All types 3 ohm output. Miniature transformerless push-pull.

- 5 watt 12/18 v., **69/6,** p.p. 1/6. 1½ watt 12 volt, **57/6.** p.p. 1/6. Z12 amplifier, **89/6,** p.p. 1/6. Mono preamplifier, **79/6.** p.p. 1/6. Stereo preamplifier, **£9.19/6,** p.p. 2/6. Mains Units: for 5 watt, **54/-,** p.p. 2/6. For Z12, **79/6,** p.p. 2/6.
- Mono Preamplifier. Switched input for P.Us, mic., tuner, etc. Treble/bass volume controls. Output 10 mV for any transistor amplifier 5/10 mV input, **79/6.** p.p. 1/6.

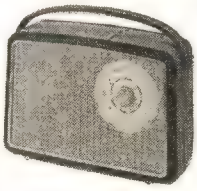
TOURMASTER TRANSISTOR CAR RADIO BRITISH MADE

7-Transistor MW/LW Car Radio, 12 volt operated. 3 watt output. Push-button wavechange. RF stage. Supplied built boxed, ready to use with Speaker and Baffle. Car fixing kit and manufacturers' current guarantee. Special Bargain Offer. Buy Now!

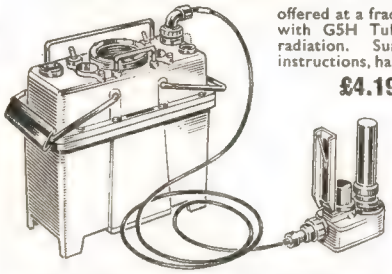
LIST PRICE 15 GNS. ● Push-button version. **£11/19/6** p.p. 4/6. **£7.19.6** P.P. 4/6

REGENT-6 MW/LW POCKET RADIO TO BUILD
6-Transistor superhet. Geared tuning. Push-pull speaker output. Moulded cabinet 5 × 3 × 1¼in. Phone socket. **TOTAL COST TO BUILD 69/6.** P.P. 2/-. Full tuning on both bands. Circuit and Details on request.

7-TRANSISTOR MW-LW SUPERHET PORTABLE TO BUILD
New printed circuit design with ½ watt full power output. Fully tunable on both mw/lw bands. 7 Transistors plus diode, push-pull circuit. Fitted 5 inch speaker, large ferrite aerial and Mullard transistors. Easy to build with terrific results. All local, pirate and continental stations. Handbook free on request. **TOTAL COST TO BUILD £8/19/6.** P.P. 3/6.



PORTABLE GEIGER COUNTERS FOR MEASUREMENT RADIO-ACTIVITY



offered at a fraction of cost ● Supplied with G5H Tube, for testing Gamma radiation. Supplied complete with instructions, haversack, cables and probe

£4.19.6 p.p. 10/-

BRAND NEW

★ **Ever Ready Batteries for above** (2 × 150 volt required). 15/- pair.

QUARTZ CRYSTALS

1 mc/s. HC6U sub-min.	20/-
6/12 volt 80C oven	22/6
1 mc/s. plus 100 kc/s. 3 pin	22/6
455 kc/s. AR88	15/-

GEIGER TUBES

M2H	22/6	931A photo mult. with base	60/-
G5H	22/6	NSP2 Strobe tube	25/-
G12H	39/6	Z801u Tube	15/-
		Large range in stock.	

NUMICATORS

Mullard Z520M with base	22/6
Hivac YN3 wire leads	15/-
Dekatron GC10D, GS10D, ea	30/-
Also GS10/cs., GS12c/s., GC10BS., each	25/-

Complete range of Valves/Tubes/Crystals and Semi-conductor Devices in stock. Catalogue 24 pp. 1/-

Suppliers of quality components & equipment for more than 20 years.

MAYFAIR PORTABLE ELECTRONIC ORGAN

NOW AVAILABLE THREE WAYS
- **COMPLETE KIT OF PARTS**
- **BUILT AND TESTED**
- **PRE-BUILT ASSEMBLIES**

REVERBERATION UNITS AND RECOMMENDED SPEAKERS AND AMPLIFIERS IN STOCK.

Designed by L. W. Roche.

STRAIGHTFORWARD TO BUILD AND TUNE—EASY TO PLAY—FULLY GUARANTEED. ALL PARTS AVAILABLE SEPARATELY—ASTOUNDING VALUE AND PERFORMANCE. START TO BUILD AS PARTS AVAILABLE SEPARATELY FROM STOCK FOR AS LITTLE AS £5. TOTAL COST TO BUILD **99 gns.** (Carriage etc. U.K. 30/-.)

● Plug-in printed circuits ● 170 transistors and devices ● 10 selected tone colours ● Fully sprung keyboard ● Vibrato ● 6 Octaves of generators ● Simple locked-in tuning ● 110/250 volt mains unit ● Cabinet size 30½in. × 15½in. × 9in. ● Weight 35 lb. Cabinet with detachable legs, music stand and foot swell pedal. ● Fully detailed building manual with photos, drawings and full circuits. (Available separately 20/- post paid.)

COMPLETE RANGE OF ORGAN PARTS IN STOCK.
DETAILED LISTS ON REQUEST
H.P. FACILITIES AVAILABLE
TRADE AND EXPORT SUPPLIED
'BELGRAVIA' CONCERT ORGAN. Details or request.

FULLY DETAILED LEAFLET AND PRICE LISTS ON REQUEST.

CALL FOR DEMONSTRATION AND PLAY THE MAYFAIR.

LIST OF OVER 650 TRANSISTORS—Semi-Conductor Devices—SCR's. (Thyristors)—Field Effect Types—Tunnel Diodes—Zeners—Silicon Rectifiers. Sent FREE on request, List No. 36.

Transistors—Semi-Conductors—Valves—Crystals. 2,000 LISTED ITEMS. 1/- Post Free. Send for comprehensive New 24-Page Illustrated List. 650 Transistors and Devices. 700 Valves and Tubes. 600 Quartz Crystals.

NEW LOW PRICES. FULLY GUARANTEED.

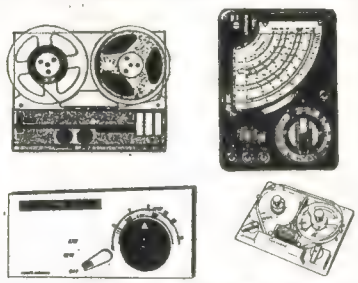
SCR's (SILICON CONTROLLED RECTIFIERS)

1 amp. Series (wire ends):				
50	100	200	300	400 p.i.v.*
5/-	5/-	9/6	10/-	11/6	12/6
3 amp. Series (stud mounting):				
50	100	200	300	350	400 p.i.v.*
6/-	7/6	10/-	11/6	12/-	12/6
7 amp. Series (stud mounting):				
100	200	300	400 p.i.v.*
12/6	13/6	15/-	17/6

*Suitable for 350 v. r.m.s.

All the above are Brand New, marked and Fully Guaranteed. Full Data is included in our 24 page Supplement at 1/- Post Free.

2N404	6/-	BCY38	9/6	GET113	5/-
2N503	12/6	BCY39	12/6	GET114	4/-
2N585	7/6	BCZ11	10/-	GET115	9/-
2N597	9/6	BFY17	9/6	GET116	8/6
2N598	7/6	BFY50	8/6	GET571	5/-
2N599	12/6	BFY51	7/-	GET572	7/6
2N697	10/6	BFY52	8/6	GET587	12/6
2N706	4/6	BFY53	6/-	GET872	6/-
2N706A	5/-	BFY10	22/6	GET874	5/-
2N708	6/-	BSY27	6/6	GET875	6/-
2N711	7/6	BSY38	5/-	GET880	9/-
2N865	7/6	BSY51	7/6	GET882	5/-
2N1040	20/-	BSY53	7/6	GET883	5/-
2N1090	7/6	BSY65	5/-	GET885	5/-
2N1091	9/6	BSY95A	4/6	GET889	6/6
2N1204A	17/6	BTY84	17/6	GET890	7/6
2N1302	5/-	BTY88	19/6	GET897	4/6
2N1304	6/-	BY100	4/6	GET898	6/-
2N1305	6/-	BY114	5/-	OC16	15/-
2N1306	7/6	BYZ11	10/6	OC19	7/6
2N1307	7/6	BYZ12	10/-	OC20	15/-
BC107	6/-	BYZ13	6/-	OC22	10/-
BC108	5/-	BYZ15	20/-	OC23	12/6
BC109	6/-	BYZ16	15/-	OC24	15/-
BCY10	7/6	GET102	6/-	OC25	7/6
BCY12	7/6	GET103	4/6	OC26	6/-
BCY31	13/6	GET105	8/6	OC28	12/6
BCY33	7/6	GET106	10/-	OC29	15/-
BCY34	8/6	GET111	9/-	OC35	10/-



BUILD A QUALITY 2 OR 4 TRACK TAPE RECORDER
3 SPEED VERSION. Using '363' Decks. ★ TWO-TRACK. Deck **£10/10/-. Martin Amplifier £14/19/6.** Cabinet and Speaker **7 gns.** Complete kits with FREE 7in. 1,200ft. tape, spare spool. **27 gns.** P.P. 15/-
Today's value 45 gns.

★ FOUR-TRACK. Deck **£13/10/-. Martin** Amplifier **£15/19/6.** Cabinet and speaker **7 gns.** Complete kits with FREE 7in. 1,200ft. tape, spare spool. Full details on request.
Today's value 50 gns. 30 gns. P.P. 15/-

GARRARD BATTERY 2-SPEED 9 VOLT TAPE DECK
Brand New with R/P head, erase/osc. head, tape cassette with tape and instructions. 2 speed 2-track. 9 volt operated. List price 13 gns. Fitted governor. Leaflet on Request. **£8.19.6** P. & P. 3/6

MULTI-METERS
PT34 1k/V **39/6.** EP30k 30k/V **£6/10/-.** TP10 2k/V **75/-.** EP50k 50k/V **£9/19/6.** ITI-2 20k/V **79/6.** 500 30/kV **£8/17/6.** TP58 20k/V **£5/19/6.** CABY M1 2k/V **49/6.**

Complete range of test equipment in stock.

M.W./L.W. QUALITY TRANSISTOR RADIO TUNER
Fully tunable superhet with excellent sensitivity and selectivity. Output up to ½ volt peak. Complete with front panel, etc. 9 volt operated. For use with any amplifier or tape recorder.
TOTAL COST TO BUILD
£3.19.6
P.P. 2/6.

1967 CATALOGUE
Have you a copy? Fully detailed and illustrated. Over 200 pages of components, equipment, etc. Over 5,000 stock items. Fully detailed and illustrated. PRICE **8/6**, post paid. Five free discount vouchers, value 10/-, with every catalogue.
200 PAGES—PLUS!
UNBEATABLE VALUE.

We can supply from stock most of the parts specified on circuits in this magazine. Ask for quotation or better still the new 1967 catalogue has everything you need—Plus free discount vouchers.

STABILISED POWER SUPPLY
Two outputs. 3.6 volt and 9.6 volt up to 250mA. each. Transistorised and Zener stabilised. 110 to 250 volt mains input in case with leads. PRICE **67/6**, p/p. 2/6.

DEAC RECHARGEABLE BATTERY
9.6 volt 225mA/H **20/-.** P.P. 1/6.

DEAC CHARGER
To charge 3.6 volt and 9.6 volt backs. Fully mains isolated in moulded case. **45/-** P.P 2/-

STEREO BROADCASTS THE REAL SOUND

FM STEREO DECODER KIT
As used by B.B.C. and G.P.O.
7-Transistor printed circuit design with stereo indicator and pre-amp. For use with any valve or transistor FM tuner. Uses Ger. and silicon transistors and pot cores to Mullard design. PRICE **£5.19.6** P.P. 2/-

GARRARD DECKS—BRAND NEW FULLY GUARANTEED

1000 mono ..	£5 19 6	*SP25 stereo.....	£10 19 6	LAB80 Mk. II	£25 0 0
AT5 mono ..	£6 9 6	*SP25 Deram....	£13 19 6	401 less cart./ arm	£27 10 0
2000 mono ..	£6 9 6	AT60 Mk.II less cart.	£12 10 0	Decoadec Mk.II	£17 17 0
2000 stereo	£6 19 6	AT60 Mk. II mono	£12 19 6	A70 less cart.	£17 17 0
3000 1 m stereo	£7 19 6	AT60 Mk.II stereo	£13 10 0	* *SP25 Pressed Turntable. Die Cast* 30/- *extra.*	
*SP25 less cart.	£9 19 6	AT60 Mk.II Deram	£15 19 6		
*SP25 mono..	£10 10 0				

(P. and P. 5/- any type). All other makes of decks and cartridges in stock

HI-FI EQUIPMENT
Complete range in stock at special prices. Full details in new 1967 catalogue.
Visit our Hi-Fi showroom
Stock list free on request

HENRY'S RADIO LTD.
303 EDGWARE RD., LONDON, W.2.
Tel. 01-723-1008/9
Open Mon. to Sat. 9-6. Thurs. 1 p.m.
Open all day Saturday
ELECTRONIC COMPONENTS A SPECIALITY

AMERICAN
TEST & COMMUNICATIONS EQUIPMENT

AN/APN-9	Loran Receiver Indicators, suitable for navigation or Scope conversion, price from £5. S.A.E. for details.
AN/VRC-19	F.M. Transceivers. 152/174 Mc/s. £10.
AN/URC-4 & AN/URC-11	"Handy-Talkies"
AN/ARN-6 & AN/ARN-44	Compass Receivers.
AN/ARN-14	Power Supplies DY-66.
AN/FPN-13	X band Radar Beacons.
CU-168/FRR	2/32 Mc/s Antenna Couplers.
AN/URM-30	Test Set for AN/URC-4's.
AN/URM-61	Signal Generator 1.8/4 Gc/s.
TS-47	Test Oscillator 40/500 Mc/s. £25.
T-216/GR	XTL Controlled Signal Generator 225/399.9 Mc/s.
TS-118/AP	RF. Wattmeters.
TS-27/TSM	R-C Bridges.
TS-170/ARN-5	I.L.S. Test Set.
TS-297/U	Multimeters.
TS-382D/U	AF/RF Signal Generators, 20 cps/200 kc/s.
TS-497B/UR	Signal Generator 2/400 Mc/s.
TS-147A/UP	Radar Test Sets.
TS-917A/CG	(Stelma TDA-2) Telegraph Distortion Analysers.
ME -22/PCM	Decibel Meters-45/+25 DBM.
General Radio	1550A Octave Band Noise Level meter.
Tektronix	541, 543 & 545 spare Tubes Type 5BHP2A. Price £14.

★ GENERAL CATALOGUE AN/102 1/- ★
★ U.S. Mil. Semiconductor Price List S.A.E. ★

SUTTON ELECTRONICS
Salthouse, Nr. Holt, Norfolk. Cley 289

WW—136 FOR FURTHER DETAILS

New 4th Ed.
GENERAL ELECTRIC S.C.R. MANUAL

This new 500 page edition has been published to coincide with the 10th anniversary development of the first Silicon Rectifier by General Electric. It contains much new information including new chapters on triac, regulating motor controls as well as specifications on hundreds of new higher performance thyristors.
25/- Postage 1/6

INTER: G.E.C. TRANSISTOR MANUAL. 18/-. Postage 2/-.

MULLARD PAL COLOUR TV. 12/6. Postage 1/-.

COLOUR TELEVISION SERVICING HANDBOOK by W. Hartwich, Vol. I. **50/-.** Postage 2/-.

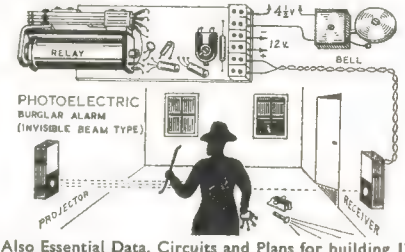
RADIO HANDBOOK by W. I. Orr. **84/-.** Postage 3/-.

MATHEMATICS FOR RADIO & ELECTRONICS TECHNICIANS by Dr. I. F. Bergtold. **50/-.** Postage 2/-.

RADIO VALVE DATA 8th ed. compiled by "WW". **9/6.** Postage 1/-.

THE MODERN BOOK CO.
BRITAIN'S LARGEST STOCKIST
of British and American Technical Books
19-21 PRAED STREET
LONDON, W.2
'Phone: PADdington 4185
Closed Sat. 1 p.m.

PHOTOELECTRIC KIT
Build 12 EXCITING PHOTOELECTRIC DEVICES on a Printed Circuit Chassis
CONTENTS: 2 P.C. Chassis Boards, Chemicals Etching Manual, Infra-Red Sensitive Photocell, Latching Relay, 2 Transistors, Resis., Cond.' Pot., Terminal Block. Elegant Case, Screws, etc. In fact, everything you need to build a simple but efficient Photo-Switch/Burglar Alarm/Counter, etc. (Project No. 1) which can be modified for modulated light operation (Projects Nos. 2 and 3).



Also Essential Data, Circuits and Plans for building 12 PHOTOELECTRIC PROJECTS. (1) Simple Photo-Switch. (2) Modulated Light Alarm. (3) Long Range Stray-Light Alarm. (4) Relay-less Alarm. (5) Warbling-Tone Alarm. (6) Closed-Loop Photoelectric Alarm. (7) Projector Lamp Stabiliser. (8) Electronic Projector Modulator. (9) Mains Power Supply Unit. (10) Automatic Car Parking Lamp Controller. (11) Super Sensitive Relay-less Modulated Light Alarm. (12) Car Automatic Headlamp Dipper. Basic Kit: **39/6.** Post and Packing 2/6 (U.K.).

OPTICAL KIT
Everything needed (except plywood) for building 1 Folded-Beam Projector and 1 Photocell Receiver to suit PHOTOELECTRIC PROJECTS. CONTENTS: 2 lenses, 2 mirrors, Infra-Red Filter, 2 45 deg. Blocks. Projector Lamp Holder and Bracket. Plans, etc. Optical Kit: **19/6.** Postage and Packing 1/6.
Send a S.A.E. for full details, a brief description and Photographs of all 52 Radio, Electronic and Photoelectric Projects. Assembled. Dept. Y.E.1

EXPERIMENTAL ELECTRONIC ENG.
333 York Rd. LONDON S.W.11

WW—137 FOR FURTHER DETAILS

OSMABET LTD.

WE MAKE TRANSFORMERS AMONGST OTHER THINGS.
AUTO TRANSFORMERS. 0-110-200-220-240 v. A.C. up or down, fully shrouded, fitted terminal blocks, 50 w. **22/6**; 75 w. **27/6**; 100 w. **32/6**; 150 w. **37/6**; 200 w. **55/-**; 300 w. **70/-**; 400 w. **85/-**; 500 w. **120/-**; 600 w. **135/-**; 1,000 w. **160/-**; 1,500 w. **£12**; 2,000 w. **£17**; 3,000 w. **£21**; 4,000 w. **£25**.
MAINS ISOLATION TRANSFORMERS. Input 200-240 v. A.C., 1 : 1 ratio, 100 w. **70/-**; 200 w. **110/-**; 500 w. **240/-**.

MAINS TRANSFORMERS. Input 200-240 v. A.C. TX1 425-0-425 v. 250 mA., 6.3 v. 4 a. ct., 6.3 v. 4 a. ct. 0-5-6, 3 v. 3 a. **110/-**; TX2 250-0-250 v. 150 mA., 6.3 v. 4 a. ct. 0-5-6, 3 v. 3 a., **60/-**; TX4, 300-0-300 v. 60 mA., 6.3 v. 2 a. c.t. 6.3 v. 1 a., **45/-**; TX5, 300-0-300 v. 120 mA., 6.3 v. 1 a., 6.3 v. 2 a. ct., 6.3 v. 2 a. **60/-**; TX7, 45-0-45 v. 1 a. **50/-**; TX8, 250-0-250 v. 65 mA., 6.3 v. 1.5 a. **22/6**. TX1M, 250 v. 60 Ma., 6.3 v. 075 a., 6.3 v. 1.5 a. **15/-**.

INSTRUMENT TRANSFORMERS. Prim. 200-240 v. A.C., OMT4, Tapped sec., 5-20-30-40-60 v.; giving 5-10-15-20-25-30-35-40-55-60, 10-0-10, 20-0-20, 30-0-30 v. A.C. 1 a. **27/6**; 2 a. **37/6**. OMT5, Tapped sec. 40-50-60-80-90-100-110 v., giving 10-20-30-40-50-60-70-80-90-100-110, 10-0-10, 20-0-20, 30-0-30, 40-0-40, 50-0-50 v. A.C. 1 a. **40/-**.

HEATER TRANSFORMERS. Prim. 200/250 v. A.C.: 6.3 v. 1.5 a. **9/6**; 6.3 v. 3 a. **15/-**; 6.3 v. 6 a. **25/-**; 12 v. 1.5 a. **15/-**; 12 v. 3 a. **22/6**; 12 v. 0.5 a. **7/6**; 24 v. 3 a. **50/-**; 24 v. 5 a. **70/-**; 24 v. 8 a. **110/-**; 24 v. 12 a. **140/-**.
Comprehensive range of transformers and chokes stocked. Carriage extra all transformers from 3/6 to 7/6 each.

TRANSFORMERS WOUND TO YOUR SPECIFICATION

BULK TAPE ERASER, and head demagnetiser, 200/250 v. A.C., suitable any size spool, any type head. **35/-**, leaflet S.A.E.
BATTERY ELIMINATORS. Input 200/250 v. A.C. output 9 v. D.C.: PP9, 150 mA. **45/-**; PP3 15 mA. **17/6**. Leaflet S.A.E.

CONDENSERS, Electrolytic, 2,500/50 v. **7/6**; 6,000/15 v. **3/6**; 1,000/25 v. **2/6**; 100/450 v. **3/6**; 500/330 v. **7/6**; 100 × 200/250 v. **5/-**; 200/450 v. **5/-**; min. postage 1/6.

LOUDSPEAKERS—SPECIAL OFFER. New stock, famous make. Heavy duty 12in. 15 watt or 25 watt, 3 or 15 ohms. List **£5/5/-**; 35 watt, 15 ohms. List **£8/8/-**. LES8 20% Discount, while stocks last. Carriage extra 5/6 each.

GARRARD UNITS, less cartridge, 1000, **100/-**; 2000, **110/-**; 3000, **130/-**; SP25, cast, **£9/15/-**; AT60 II, **£11**; SP22, **90/-**; B.S.R. Super Slim UA25 autochanger with cartridge, **100/-**. All New Brand. Plus carriage 7/6.

FLUORESCENT LOW VOLTAGE LIGHTING. Input 6, 12, 24 v. D.C. Extensive range of fluorescent fittings and inverters. Lists S.A.E. **VIBRATORS.** 4 pin, 12 v. D.C., non-synchronous. **7/6**. Post 2/-.

S.A.E. all enquiries please. Mail Order Only
46 KENILWORTH ROAD, EDGWARE, MIDDX.
Tel.: STOnegrove 9314.

ALL GOODS GUARANTEED

CONVERTOR/BATTERY CHARGER
Input 12V D.C.—output 240V 50 c/s 170 watts max. Input 240V 50 c/s—output 12V 5 amp DC. Fully fused with indicator lamps. Size 9½ × 10 × 4½. Weight 19 lbs. An extremely compact unit that will give many years reliable service, supplied with plug and leads. Only **£4/10/-**. P. & P. 15/-.

AIRMEC OSCILLOSCOPES
3" tube TB 40 c/s/40 kc/s 50-0-50 Micro/amp meter, calibrated for Y deflection. Y amplifier DC to 2 mc/s. Set of leads. Size 19" wide × 5 × 15. Normal 200/250 volt 50 c/s input. Ideal for TV servicing. Mint condition Only **£12/10/-**. P. & P. £1.

Transistors			Valves		
OC35 ..	4/- ea.		6AK5 ..	3/6 ea.	
OC71 ..	2/- ea.		6SN7 ..	3/- ea.	
OC75 ..	2/6 ea.		12AT7 ..	3/- ea.	
OC200 ..	3/- ea.		ECL80 ..	2/6 ea.	
GET885 ..	4/- ea.		EF80 ..	6d. ea.	
ACY17 ..	4/- ea.		EB91 ..	1/6 ea.	
ACY19 ..	5/- ea		E180F ..	12/6 ea.	
2N696 ..	10/- ea.		DL92/94 ..	4/- ea.	
2N1305 ..	4/6 ea.		12SN7/B36 ..	2/6 ea.	
2S018 ..	15/- ea.		6CH6 ..	5/- ea.	

COUNTER TUBES GC10B—12/6 ea.—suitable trigger tubes CV2224/GI/371K—15/- ea. GTE175M—8/- ea.
RELAYS
American miniature gold contacts, 4-pole co 48V. Brand new, boxed—12/6 ea.
American miniature 4-pole co 12/24V 200 ohms, sealed—5/6 ea.
3000 Series 5K ohms, 2-pole make, power contacts—3/6 ea.
Siemens Sealed HS 48V spco type H96E, 3/- ea.
American time delays 28V 15-3000 secs.—20/- ea.
RECTIFIERS 2 amp stud 100 piv—3/- ea. Bridge—8/6.
TRANSFORMERS, all 200/250 inputs Tapped 0-6-12-18. 3 amp—15/- ea. 7 amp.—30/- ea.
NEW DIODES. Mullard genuine OA81—1/6 ea. CV448/425—1/-.
METROSILS. Ideal pulse suppression, relays, etc. —2/- ea.
CONDENSORS. Tantalum 140mfd 30v DC working—2/6 ea.
8mfd 600vw by TCC, Dubilier, complete with clips 3/- Cash with order. Post paid over 10/-.

CHILTMEAD LTD.
22 Sun Street, Reading, Berks

You are interested in Radio and T.V.?—Why not

PUT SOME LETTERS AFTER YOUR NAME

You can rapidly qualify in your spare time by means of an absorbingly interesting Chambers Postal Course. We offer expert and highly personal training backed by a " SATISFACTION-OR-MONEY-BACK " Agreement. Over 75 years' experience . . . thousands of successes.

FREE 100-PAGE GUIDE

Choose from hundreds of Courses—Practical Radio (apparatus supplied), Radio & T.V. Servicing, Applied Electronics, P.M.G. Cert., City & Guilds, R.T.E.B., A.M.I.E.R.E., Radio Amateurs Exam., etc. Send today for the informative 100-Page *Chambers Guide To Success*—FREE. (Please state Career, exam. or subject of interest).

Chambers College

(Dept. 855F) 148 Holborn, London, E.C.1.

WW—138 FOR FURTHER DETAILS

ADVANCE TEST EQUIPMENT

VM76 **Valve Voltmeter**
R.F. Measurements in excess of 100 mHz and d.c. measurements up to 1,000V with accuracy of ±2%. D.c. range—300 mV-1 kV f.s.d. A.c. range—300 mV-300 V r.m.s. Resistance in 8 ranges, 0.02-500 Megohms.
Manufacturer's price £90: Our price £72

VM77C: **A.C. Millivoltmeter**
1 mV-300 V full scale in 12 ranges. Freq. range 15 c/s-4.5 Mc/s. Input impedance 10 Megohms 20 p.f. Calibrated in r.m.s. volts for sine wave input and dB. 100-250 V a.c. input.
Manufacturer's price £55: Our price £40

VM78: **A.C. Millivoltmeter**
Transistorised. 1 mV-300 V in 12 ranges. Freq. 1 c/s-1 Mc/s. Input impedance 2 Megohms 60 p.f. Calibrated in r.m.s. for sine wave and input dB.
Manufacturer's price £70: Our price £55

TT1S: **Transistor Tester (CT472)**
Suitable for measuring medium and low powered transistors. Current gain (B) can be measured in range 10 to 500 for p.n.p. and n.p.n. types, either in circuit using the clip on probes provided. Small compact instrument.
Manufacturer's price £57: Our price £37/10/-

VM79: **UHF Millivoltmeter**
Transistorised. A.c. range 10 mV-3 V f.s.d., 10 ranges. D.c. current range 0.01 μA-0.3 mA f.s.d., 10 ranges. Resistance 1 Ohm-10 Megohms in 7 decade ranges. Complete with probe.
Manufacturer's price £180: Our price £125

J1B **Audio Signal Generator**
15 c/s-50 kc/s in 3 ranges. Output 600 Ohms, 0.1 mW-1 W (0.25-24 V), variable. Atennuation 20 dB-600 Ohms (Atennuator is incorporated), output 10 mW (2.5 V). 100-250 V a.c.
Manufacturer's price £46: Our price £30

J2B **Audio Signal Generator**
Same specification as for the J1B except that this model has an additional 2 in. meter calibrated 0-40 V a.c.
Manufacturer's price £50: Our price £35

H1B: **Audio Signal Generator**
15 c/s-50 kc/s in 3 ranges. Sine wave 200 μV-20 V r.m.s. Square wave 1.4 mV-140 V peak to peak (approx.). 100-250 V a.c.
Manufacturer's price £42: Our price £30

SG66: **LF Generator**
5 c/s-125 kc/s. Sine and square wave in 5 ranges. Output is indicated with 2 in. square meter. Decade atennuator range of 50 dB. 100-250 V a.c.
Manufacturer's price £95: Our price £65

Special offer of 10% discount for schools and Technical Colleges, etc. These are current production, manufactured in U.K. by Advance Electronics Ltd. (not discontinued models). BRAND NEW, all in original sealed carton. Carr. 10/- extra per item.

S.A.E. for all enquiries. If wishing to call at Stores, please telephone for appointment.

W. MILLS

3-B TRULOCK ROAD, TOTTENHAM, N.17
Phone: Tottenham 9213

DE-ICER Controller Mk. 3. Contains 10 relays D.P. changeover heavy duty contacts, 1 relay 4P, C/O (235 ohms coil). Stud switch 30-way relay operated, one five-way ditto, D.C. timing motor with Chronometric governor 20-30 volts 12 R.P.M.; geared to two 30-way stud switches and two Ledex solenoids, 1 delay relay, etc., scaled in steel case, size 4×5×7in. £3 each, post 7/6.

GEARED MOTORS (Reversible).
24 v. Open gears with governor approx. 10 r.p.m., 25/-, post 2/6.
A.C. Motor 115 v. 50 c/s. 1/300 H.P., 3000 r.p.m. Capacitor 1mfd., 25/-, post 3/-. Dalmotor SC5, 28 v. D.C. at 45 amps; 12,000 r.p.m. output 750 W. (approx. 1 h.p.), brand new, £2/10/- each, post 7/6.
28 v. D.C., 200 r.p.m. (ideally suited for opening garage doors), current consumption approximately 6 amps. Price £3/10/-, postage 7/6.

CONDENSERS. 10 mfd. 1,000 v., 12/6, post 2/6. 8 mfd., 1,200 volts, 12/6, post 3/-. 8 mfd. 600 volts, 8/6, post 2/6. 0.25 mfd., 2 kv., 4/-, post 1/6.

AUTOMATIC PILOT UNIT Mk. 2. This complex unit of diodes and valves, relays, magnetic clutches, motors and plug-in amplifiers, with many other items, price £7/10/-. £1 carriage.

U.S.A. DESK MICROPHONE CRV/5108/A. Complete with 7 yards of screened cable and universal jack (adjustable), 10/- each, post 3/-.

TS125A, with leads, etc., price, £25, carriage 10/-.

APNI ALTIMETER TRANS./REC., suitable for conversion 420 mc/s. complete with all valves 28 v. D.C. Dynamotor and 3 relays, 11 valves, price £3 each, carr. 10/-.

TRANS./RECEIVER UNIT Mk. 3. Freq. 2 to 8 mc/s., RT or CW., MCW., requires external power supply. Complete station, £9, carriage 25/-. Trans-rec. only, £3/10, carr. 15/-.

ROTARY TRANSFORMERS. 24 v. input, 175 v. at 40 mA output 25/-, plus 2/- post. 12 v. input, 225 v. at 100 mA. output, 25/-, plus 3/- post (All the above are D.C. only).

CANADIAN C52 TRANS./REC., freq. 1.75 to 16 mc/s. on three bands. R.T., M.C.W. and C.W. Crystal calibrator, etc., power input 12 volt D.C., new condition complete set, £50, carr. £2/10/-. Used condition in working order, £25, carr., £2/10/-. C52 receiver only (less outer case), £8/10/-, carr. 15/-. Transmitter only £7/10/-, carr. 15/-. Power unit C52 rec., new £3/5/-. Used power units in working order, £2/5/-, carr. 10/-.

AVO MULTIRANGE No. 1 ELECTRONIC TEST SET: £25 each, carr. £1.

HRO RECEIVER. Model 5T. This is a famous American High Frequency superhet, suitable for CW., and MCW., reception crystal filter, with phasing control. AVC, and signal strength meter. Freq. range 50 kc/s. to 30 mc/s., with set of nine coils. Receiver only in working order, £18/10/-, carr. 15/- each. Set of nine coils, £12/10/-, available only with set. Power unit for HRO, 100/240 v. A.C., £2/15/-, carr. 10.-.

SPECIAL OFFER: Complete HRO SET (Receiver, Coils & Power Unit) for £30, plus 30/- carr.

HRO-M-SETS available with UX type valves; secondhand cond., with 5 coil and power unit, £20 each, carr. 30/-.

CONVERTERS. Type 8a, 24 v. D.C., 115 v. A.C. at 1.8 amps 400 cycles, 3-phase, £6/10/- each, post 8/-.

ADAPTOR WAVEGUIDES TO COAXIAL UG 183/U (M Band). Price 30/- each, post 3/-.

TRANS./REC.510/A. This is a lightweight transmitter/receiver principally used for long range communications. Frequency tunable 2-10 Mc/s. and has facilities for "VOICE" or "CW" working. The operator can set up 4 crystal controlled channels within this band and select the required frequency by means of a switch on the panel of the transmitter. Power requirements 1½ v. and 90-7½ v. The power output is approx. 0.2 watts for "VOICE" (unmodulated) and 0.5 watts for "CW". Suitable for mobile units or can be used as a base station with improved aerial system. In excellent condition. £15 each, carr. 10/-.

MARCONI DEVIATION TEST SET, TF934: freq. 2.5-100 Mc/s. Can be extended to 500 Mc/s. Deviation range 0-5, 0-25 and 0-75 Kc/s. £35 each, carr. £1.

MARCONI IMPEDANCE BRIDGE, TF-373: inductance 5μh-100H in 5 ranges, capacity 5pF-100μF in 5 ranges, resistance .05 meg.-1 meg., power supply 250 v. A.C. £37/10/- each, carr. 15/-.

CT.49 ABSORPTION AUDIO FREQUENCY METER: freq. range 450 c/s-22 Kc/s., directly calibrated. Power supply 1.5 v.-22 v. D.C. £12/10/- each, carr. 15/-.

TACAN. Trans./Receiver, same as ARN21, British made, STC, TR9171 complete with five 2C39As with associated valve-holders. As new, price £25. Used condition, £15, carriage £1.

RELAY UNITS. 2 high speed relays H96E, 1700 + 1700 ohms, 1 change-over relay 14,000 ohms, 1 CV 455, 100 ohms and 1 meg. pot., etc. Mounted in box, 4in. × 6in. × 3in., 30/- each, 4/- post.

RECEIVERS. Type AR88D: freq. 540 Kc/s-32 Mc/s. £45 each, carr. £2.

AR88 SPEAKERS. New in cartons, metal case with black crackle finish. 59/6 ea., post 7/6.

AR88 SPARES. Antenna Coils L5 and 6 and L7 and 8. Oscillator coil L.55. Price 10/- each, post 2/6. By-pass Capacitor K.98034-1, 3 × 0.05 mfd. and M.98034-4, 3 × 0.01 mfd., 3 for 10/-, post 2/6. Trimmers, 95534-502, 2-20 p.f. Box of 3, 10/-, post 2/6. Block Condenser, 3 × 4 mfd., 600 v., £2 each, 4/- post. Filter Choke, L45 and 50, K901433-501, 25/- each, 4/- post.

MARCONI VARIABLE ATTENUATOR: TF338B, 0-150dB, impedance 600 ohms, as new, £10 each, used cond., £5 each, carr. 15/-.

AIRCRAFT RECEIVER ARR2. 235-258 Mc/s. tunable, 24 v. D.C. input, £3 ea. 7/6 carr.

SIGNAL GENERATORS:
MARCONI TF-144G: freq. 85 Kc/s.-25 Mc/s, internal and external modulation, power supplies 200/250 v. A.C. (Secondhand cond.), price £25 ea.; or available in transit case complete with spares, in first class condition £30 ea., carr. on both 30/- ea.
TS155c/UP (as new): price £75 each, carr. £1.
CT53. Freq. range 8.9-300 Mc/s. with calibration chart. Output 1μV-100 mV. internal square wave and sinewave modulation at 100 c/s., external modulation 50 c/s.-10 Kc/s, 230 v. A.C. Complete with chart, etc., price £27/10/- ea., carr. £1.
MARCONI TF801A/1 Freq. 10-300 Mc/s, 4 bands, output 200mV, Attenuator 0-110dB. Input 75 ohms. **£65 each,** carr. £1.
MARCONI TF517-F/1: Covering 10-18 Mc/s, 33-58 Mc/s., 150-300 Mc/s. £10 each, carr. £1.
MARCONI CT218: price £65 each, carr. 30/-.
CT.480 and 478: 1.3-4.2 Mc/s, F.M. or A.M., price £75 each, carr. 30/-.

TELEPHONE EQUIPMENT:
GPO STANDARD DESK TELEPHONES, new £2 each, or £3/15/- a pair, post 7/6 per telephone.
GPO 'CANDLESTICK' TYPE TELEPHONE. Upright model with receiver, ideal novelty for converting to lampshade. Available any colour, £5/10/- ea., post 7/6.
TELEPHONE WIRE: 220 yds., 15/- a roll, post 4/-.
GPO TERMINAL BLOCKS, FUSE AND PROTECTOR, 7/6 each, post 2/6.
TELEPHONES (PORTABLE) TYPE "F". Suitable for all cutdoor activities up to a range of 5 miles, in excellent condition. Price, complete with batteries, £5/10/- per pair, carriage 10/-.
TELEPHONES TYPE "L". Portable in excellent condition. £3 a pair (without batteries), post 10/6.
TELEPHONE EXTENSION CORD. Brown, 3-way; comes in lengths of 6ft. and 14ft. 7/6 and 15/- respectively. Post 2/6.

BATTERY CHARGERS: 100-250 v. A.C. Input 12 v. 15 amp. Output (2-Rate Charger complete with Sun-vick thermal switch for fast or trickle charge), price £12/10/- each, carr. 30/-.

COMMAND RECEIVERS: Model 3-6 Mc/s. and 6-9 Mc/s., as new, price £5 10/- each, post 5/-.

BC-433-G COMPASS RECEIVER: Freq. 200-1,750 kc/s. in 3 bands, suitable for aircraft, boats, etc. Complete with 15 valves, power supply input 24 v. D.C. at 2 amps. Receiver only £5 each, Carr. 15/-.

TCS MODULATION TRANSFORMERS, 20 watts, pr. 6,000 C.T., sec. 6,000 ohms. Price 25/-, post 5/-.

NIFE BATTERIES: 6 v. 75 amps., new, in cases, £15 each, £1 carr.; 6 v. 160 amps., new in cases, £25 each, £1/10/- carr.; 4 v. 160 amps., new, in cases, £20 each, £1/10/- carr.

L.R.7 Cells, only, 1.5 v. 75 amps., new, £3 each, 12/- carr,
The above batteries are low resistance designed to give heavy surge for starting and can be stored for long periods without any effect to their performance.

WAVE GUIDES FLEXIBLE CG-182/APM40. Length 18 inches. Price £2 each, post 4/-.

MACHMETERS: Range 0 : 1 and 0 : 1.2, 6A/3384 & 5325 respectively, price 30/- each, postage 5/-.

FUEL INDICATOR Type 113R : 24 v. complete with 2 magnetic counters 0-9999, with locking and reset controls mounted in a 3in. diameter case. Price 30/- each, postage 5/-.

AVOMETER MODEL 7 Secondhand condition, £12/10/- each, post 10/-.

DRY BATTERIES, NO. 1. HT 90 v. and 7½ v., size 2½in. × 3½in. × 5in., 5/- each, or 5 for £1, post 4/- and 7/6 respectively.

BATTERY NO. 4 (suitable for bells, etc.). 4½V, size 4½in. × 6in. × 2½in. 5/- each. Post 3/-.

UNISELECTORS (ex equipment): 10 Bank, 50 Way, alternate wipe, £2/5/- ea. 6 Bank, 25 Way, alternate wipe, £2/2/6 ea. 8 Bank, 25 Way, £2/5/- ea. 6 Bank, 25 Way, £2 ea. 4 Bank, 25 Way, 35/- ea. All the above are 75 ohm coil. Postage 4/- per uniselector.

DALMOTORS (All ex equipment):
Actuator Type SR-43: 28 v. D.C. 2,000 r.p.m., output 26 watts, 5 inch screw thrust, reversible, torque approx. 25 lbs., rating intermittent, price £3 each, postage 5/-.

Model PM84: 28 v. D.C. @ 2 amps., 4,500 r.p.m., output 40 watts continuous duty complete with magnetic brake. Price £2 each, postage 4 -.

Model SR-2: 28 v. D.C. 7,000 r.p.m., duty intermittent, output 75 watts, price 25/- each, postage 4/-.

MOTORISED ACTUATOR: 115 v. A.C. 400 c/s. single phase, reversible, thrust approx. 3 inches complete with limit switches, etc. Price £2/10/- each, postage 5/- (ex equipment).

D.C. MOTOR: 27 v. D.C. with gear box, 4 r.p.m. Price 25/-, postage 3/- (ex equipment).

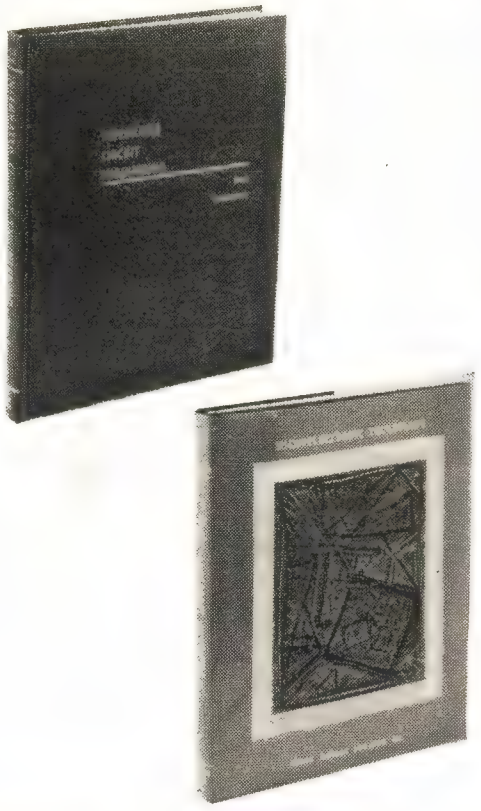
GEARED MOTOR: 28 v. D.C. approx. 200 r.p.m. complete with precision potentiometer 40k ±3%, 2.5 watts linear plus or −0.25% Price 30/-, postage 4/- (ex equipment).

S.A.E. for all enquiries. List available 6d.
If wishing to call at Stores, please telephone for appointment.

W. MILLS

3-B TRULOCK ROAD, TOTTENHAM, N.17
Phone: Tottenham 9213

Two New Titles From Iliffe Books



Integrated Circuit Engineering

Basic Technology

By the Staff of Integrated Circuit Engineering Corporation, Phœnix, Arizona

391 pp fully illustrated **£9.10s net**

Microelectronic Technology

Selected Articles from Semi-conductor Products and Solid State Technology

Edited by Samuel L. Marshall

232 pp fully illustrated **£5.10s net**

Both books available in the U.S.A. and Canada from Boston Technical Publishers, Inc., Massachusetts, U.S.A.

available from leading bookseller

ILIFFE BOOKS LTD DORSET HOUSE, STAMFORD ST., LONDON, S.E.1

COLOMOR *Transistor* POWER PACKS

Static power packs employing semi-conductors and transistors.

For use in AIRCRAFT, MARINE AND MOBILE EQUIPMENT. YOUR ENQUIRIES INVITED.

A highly efficient portable mains supply, without moving parts, is obtained by converting 6, 12 or 24 v. battery power into any required D.C. voltage, or A.C. voltage at 50 cycles or other frequency. Output powers from a few watts to a kilowatt.

COLOMOR Transistor POWER PACKS are designed and manufactured to meet customers' individual requirements.

MARCONI VIDEO OSCILLATOR TF 885A. Sine wave output 25 c/s to 5 Mc/s in 2 bands, Square-wave output 50 c/s to 150 c/s in 2 bands. Freq. accur. ± 2% ± 2 c/s. Power supply 100/125/200/250 v. A.C. **£75.** Carriage 40/-.

DEVIATION TEST SET TF934. 2.5 to 100 mc/s. on Fundamentals. Can be extended to 500 mc/s. on harmonics. A.C. mains operation, **£55,** carriage 30/-.

FIELD TELEPHONES TYPE "F" housed in portable wooden cases. Excellent for communication in- and out-doors for up to 10 miles. For pair including batteries and 1/6th mile field cable on drum. **£5/10/-.** Carriage 10/-.

FIELD TELEPHONES TYPE "L" As above but in portable metal cases. Per pair including batteries and 1/6th mile field cable on drum. **£3/15/-.** Carriage 10/-.

FIELD 10 LINE MAGNETO TELEPHONE SWITCHBOARD (YA6733) withstanding all climatic conditions. Price on application.

HARNESS "A," & "B" control units, junction boxes, headphones, microphones, etc.

SUB-MINIATURE "PENNY SIZE" METERS. 1in. round, flush, ring nut mounted 500μA FSD, calibrated 0-1 mA. **20/-.** P. & P. 3/-.

PCR RECEIVERS with 12 v. vibratory supply unit **£10/10/-.**

SIGNAL GENERATOR CT 53 8-9-300 Mc/s. **£22/10/-.**

CR 150 RECEIVER, 2 Mc/s-60 Mc/s with specially built PSU for mains. **£49/10/-.**

METERS. 4½in. × 4½in., 4in. long, mirror scale panel mounted, calibrated 0-1 mA. **55/-.** P. & P. 3/-.

LABORATORY TYPE VOLTMETERS. 160 v. A.C./D.C. 8in. mirror scale in wooden boxes 9½in. × 8⅝in. × 3½in. with carrying handle, brand new, **32/-.** P. & P. 3/-.

AR.88D. RECEIVERS. Fully reconditioned **£55.** Rebuilt model **£85.** Carriage paid U.K.

SPARES FOR A.R.88.D. RECEIVERS. Ask for your needs from our huge selection.

VARIOMETER for No. 19 sets, **17/6.** P. & P. 3/-.

TELEPHONE HANDSETS. Standard G.P.O. type; new **12/-.** P. & P. 2/-.

INSET MICROPHONE for telephone handset **2/6.** P. & P. 2/-.

LIGHTWEIGHT, LOW RESISTANCE, HEADPHONES. Type H.S. 33. Largely used by pilots. Brand new **27/6.** P. & P. 3/-.

MINIATURE METERS. General Electric 1½in. round flush, clip mounted:

1 mA. D.C. **22/6** P. & P.
25 mA. D.C. **20/-** 3/-
75 mA. D.C. **18/-**
150 mA. D.C. **15/-**

"S" METER FOR H.R.O. RECEIVERS. Brand new **£2/10/-.** Carriage paid U.K. **CRYSTALS** for H.R.O. in original National Union Housing, **25/-.** P. & P. 2/-.

PHASE MONITOR ME-63/U Manufactured recently by Control Electronics Inc. Measures directly and displays on a panel meter the phase angle between two applied audio frequency signals within the range from 20-20,000 cps to an accuracy of ±1.0°. Input signals can be sinusoidal or non-sinusoidal between 2 and 30 v. peak. In excellent condition together with handbook and necessary connector. **£45.** Carriage 30/-.

END OF RANGE ITEMS

AVO ELECTRONIC MULTIMETER TYPE CT 38. A.C. mains operated, 105-125 v. and 195-255 v., 45-66 c/s. 97 measurement ranges covering D.C. and A.C. current, voltage, resistance and power output. Accuracy on D.C. ranges ±2% F.S.D. Accuracy on A.C. ranges ±3% full F.S.D. at 50 c/s. Ranges: D.C. volts 250 mV.-10,000 v. (10 m/ohms-110 m/ohms input resistance). D.C. current 10μA-25 A. Ohms: 0-1,000 m/ohms. A.C. volts 100 mV.-250 v. (with RF measuring head to 250 Mc/s). A.C. current —10μA.-25 A. Power output —50μW.-5 W. Automatic movement protection against overload. Meter reverse, balanced measurement facilities. Complete with accessories. Laboratory tested condition. **£25.** Carriage 15/-.

MICOVAC VOLTMETER BY ELECTRONIC INSTRUMENTS Ltd. A.C. mains or battery operated. A.C. and D.C. voltages from 2.5 to 480 v. A.C. voltages from 20 c/s. to 200 Mc/s, Ohms from 0-10 m/ohms. Meter reverse, balanced measurement facilities. **£12/10/-.** P. & P. 10/-. Offered at special low prices as only a few left, all are in fully tested guarantee condition.

VALVE VOLTMETER TS 428B/1. £10/10/-.

INSULATION TESTER by Evershed & Wynal, in leather case, 500 v. 100 Meg. **£17/10/-.**

FOR EXPORT ONLY

53 TRANSMITTER made up to "as new" standard. All spares available.

COLLINS TCS. Complete installationis and spare parts.

FIELD TELEPHONE SETS TYPE "J" YA 7815. Portable. Ideal for tropical climates.

R.C.A. TRANSMITTER TYPE ET 4336. 2-20 Mc/s, complete with M.O., Cryst. mult. and speech ampl. Fully tested and guaranteed. All spares available.

BC 610 E TRANSMITTER complete with speech amplifier BC 614E. Aerial tuning unit BC 939A. exciter units, tank coils, etc. Fully tested and guaranteed. All spares available.

P. C. RADIO LTD.

170 GOLDHAWK RD., W.12 SHEpherd's Bush 4946

VALVES

AC/HL 6/-	E92CC 5/-	EF95 .. 5/-	M8100 9/-	QQV06-40	UAF42 9/-	1E7G .. 7/6	5Y3GT 5/-	6F5GT 8/-	7V7 .. 5/-	COLOMOR	
ACP4 6/-	E180CC 7/-	EF183 6/6	M8142 12/-	85/-	UB1 .. 3/-	1P2 .. 2/6	5WGTB3Y	6F6G 4/-	7Y4 .. 8/-	THE VALVE WITH A GUARANTEE	
AC6PEN 5/-	E182CC 10/-	EF184 6/6	M8161 8/-	QQV06-40A	UBF80 6/6	1G6GT 6/-	9/-	6F7 .. 6/-	7Z4 .. 4/6		
AL60 .. 5/-	E1148 2/6	EH90 7/6	M8190 5/-	100/-	UCC85 6/6	1L4 .. 2/6	5Z4G .. 6/6	6F8G .. 8/6	8D3 .. 2/6		
AR8 .. 5/-	E1266 50/-	EL31 15/-	MH4 5/-	QP230 5/-	UCF80 9/6	1LA6 .. 6/-	6AB7 .. 4/-	6F12 .. 4/-	9D2 .. 3/-		
ARP3 3/-	E1415 30/-	EL32 .. 3/9	MH41 8/-	Q8150-15	UCH42 8/-	1LC6 .. 7/-	6AC7 3/-	6F13 .. 5/-	9D6 .. 2/-		
ARP12 2/6	E1524 12/6	EL34 .. 10/-	MHLD6 10/-	10/-	UCH81 6/-	1LH4 4/-	6AG5 2/6	6F17 .. 5/-	10F9 9/-		
ARTP1 6/-	E2134 8/-	EL35 .. 5/-	ML6 .. 6/-	Q8956/10 5/6	UCL82 8/-	1M21 3/6	6AG7 6/-	6F32 .. 4/-	10P14 15/-		
ATP4 3/3	EA50 .. 1/-	EL84 .. 4/3	N37 .. 5/-	Q81202 8/-	UCL83 9/-	1N21B 5/-	6AH6 10/-	6F33 20/-	11E2 15/-		
ATP7 5/6	EABC80 5/9	EL85 .. 7/6	OD3 .. 5/-	QV04/7 8/-	UF41 7/-	1N43 .. 4/-	6A7J 3/-	6G6G .. 2/6	12A6 .. 2/6		
AU7 .. 5/-	EAC91 3/6	EL91 .. 4/6	OZ4A 5/-	QQZ04-15	UF89 6/-	1N70 .. 4/-	6AK5 5/-	6H6GT 1/9	12AH7 5/-		
AZ31 .. 9/-	EAF42 8/-	EL95 .. 6/-	P21-35 14/-	57/6	UL41 7/6	1R4 .. 5/-	6AK6 6/-	6H6M 2/-	12AT6 5/-		
BD78 40/-	EB34 1/6	EL360 20/-	P41 .. 4/-					6J4WA 10/-	12AT7 4/-		
B6H .. 14/-	EB91 3/-	EM31 5/-	PC86 .. 9/-					6J5 .. 6/-	12AT7WA		
BL63 10/-	EBC33 6/-	EM80 6/-	PC88 .. 9/-					6J5G .. 2/-	5/6		
B84 .. 8/-	EBC41 8/6	EM81 7/-	PC97 .. 7/6					6J6 .. 3/6	12AU7 5/-		
B85 .. 20/-	EBC81 5/-	EM84 6/3	PC900 12/-					6J6W 6/-	12AV6 5/6		
B884 47/6	EBF80 6/6	ESU74 80/-	PCC84 5/6					6J7G 5/-	12AX7 6/-		
BT35 15/-	EBF83 7/6	ESU208 6/-	PCC89 10/-					6J7M 8/-	12AY7 10/-		
BT45 150/-	EBF89 6/9	EY51 5/6	PCC189 9/6					6K6GT 5/6	12BA6 5/6		
BT83 35/-	EBL31 20/-	EY86 6/6	PCF80 6/3					6K7 4/6	12BE6 7/-		
BYZ14 7/6	EC52 .. 4/-	EY91 3/-	PCF82 6/6					6K7G 2/-	12BH7 7/-		
CC3L .. 2/-	EC53 12/6	EZ40 .. 6/6	PCF84 6/-					6K7GT 4/9	12C8 .. 3/-		
CV71 .. 3/-	EC70 4/-	EZ41 .. 6/6	PCF86 6/-					6K8G 3/-	12E1 19/-		
CV77 6/-	EC80 .. 6/-	EZ80 .. 5/6	PCF801 3/6					6K8GT 3/3	12H6 .. 2/-		
CV1023 1/-	EC81 .. 3/-	EZ81 .. 4/6	PCF802 9/6					6K8M 8/6	12J5GT 2/6		
CV103 4/-	ECC32 4/-	F/6057 5/-	PCF805 11/-					6K25G 24/-	12J7GT 6/6		
CV315	ECC33 16/-	F/6061 5/-	PCF808 12/6					6L5G 6/-	12K7GT 7/-		
(matched	ECC81 4/-	F/6063 4/-	PCL81 9/-					6L6GA 7/6	12K8M 10/-		
pair) 120/-	ECC82 5/-	FW4/500 6/6	PCL82 7/-					6L7G 4/-	12Q7GT 5/-		
CV315	ECC83 6/-	FW4/800 8/6	PCL83 8/6					6L34 3/-	12S7 4/-		
(single) 50/-	ECC84 5/6	G1/370K	PCL84 7/-					6LD20 5/9	12SC7 4/-		
CV4004 7/-	ECC85 6/6	20/-	PCL85 8/6					6N7G 5/9	12SG7 4/6		
CV4014 7/-	ECC88 8/-	G50/2G 5/-	PCL86 8/-					6P25 12/-	12SH7 3/-		
CV4015 8/-	ECC91 4/-	G120/1B	PEN 25 4/6					6P28 .. 7/-	12SJ7 5/9		
CV4025 7/-	ECC189 9/6	17/6	PEN 46 3/-					6Q7G 5/9	12SK7 5/-		
CV4049 6/-	ECF80 7/-	G1802M 15/-	PEN220A					6R7 .. 5/6	12SN7GT 5/9		
CY31 .. 6/6	ECF82 7/-	GM4 .. 45/-	3/-					6S7 .. 7/-	12SN7GT/9		
D1 .. 1/6	ECH35 12/6	GTE175M	PFL200 17/8					6SA7 .. 7/-	12SR7 5/-		
D41 .. 3/3	ECH42 9/-	12/-	PL36 .. 9/-					6SA7GT 6/6	12Y4 .. 2/-		
D61 .. 6/-	ECH81 5/-	GU50 25/-	PL38 .. 16/-					6SC7 .. 7/-	14L7 .. 8/-		
D77 .. 3/-	ECH83 7/6	GZ32 10/-	PL81 .. 7/-					6SC7GT 5/-	14S7 .. 18/-		
DA30 12/6	ECL80 6/-	GZ34 10/-	PL82 .. 6/6					6SF7 .. 6/-	15D2 .. 6/-		
DA100 £6	ECL82 6/3	H30 .. 9/6	PL83 .. 6/-					6SG7 .. 7/-	19AQ5 5/-		
DAF96 6/-	ECL83 10/-	HL23 2/6	PL84 .. 6/6					6SH7 .. 3/6	19E2 .. 15/-		
DD41 4/-	ECL86 9/-	HL23 ' 8/-	PL500 13/6					6SJ7 .. 5/-	19G3 .. 40/-		
DET5 8/-	EF36 3/6	HL23DD 5/-	PL504 5/-					6SJ7GT 6/6	1966 .. 15/-		
DET20 2/-	EF37A 7/-	HL41 4/-	PT15 .. 13/-					6SJ7Y 8/-	19M1 .. 5/-		
DET25 15/-	EF40 .. 8/-	HVR2 9/-	PX4 .. 14/-					6SJ7Y 6/6	20P4 .. 12/6		
DF91 3/-	EF41 .. 6/-	K3A .. 30/-	PX25 12/6					6SK7 .. 7/-	21B6 .. 7/-		
DF92 3/-	EF50 .. 2/6	KT8C 28/-	PY33 8/8					6SL7GT 6/6	25L6GT 5/6		
DF96 6/6	EF52 .. 6/-	KT32 8/-	PY80 5/6					6SN7 8/-	25Y5 .. 6/-		
DK92 8/-	EF55 .. 3/-	KT44 5/9	PY81 5/6					6SN7GT 6/-	25Z4G 6/6		
DK96 6/6	EF71 .. 7/6	KT63 4/-	PY82 5/6					6SQ7GT 6/-	25Z6G 6/6		
DL63 8/-	EF72 .. 5/-	KT66 16/-	PY83 6/-					6SS7 .. 8/-	25Z6W 7/6		
DL92 4/-	EF73 .. 5/-	KT67 25/-	PY800 7/-					6SU7GT 8/6	28D7 6/-		
DL93 4/-	EF74 .. 4/-	KT71 5/-	PY801 7/-					6V6G 5/-	30C15 10/-		
DL94 5/9	EF80 .. 5/-	KT76 8/6	PZ1-35 14/-					6V6GT 7/6	30C18 11/-		
DL96 7/-	EF85 .. 4/6	KT88 22/-	PZ1-75 12/-					6V6M 8/-	30C15 10/-		
DL810 8/-	EF86 .. 6/6	KTZ41 6/-	QP21 6/-					6X4 .. 3/6	30C18 11/-		
DY86 7/6	EF89 .. 5/-	KTZ63 5/-	QP25 5/-					6X5G 5/-	30F5 8/6		
E80F 23/-	EF91 .. 3/6	L30 .. 6/-	QQV03-10					6X6GT 5/3	30FL1 10/6		
E88CC 12/-	EF92 .. 2/-	L63 .. 6/-	27/6					6Y6G 8/-	30FL12 19/-		
E90CC 10/-								6-30L2 8/6	20FL13 6/-		
								6Z4 .. 5/-	30FL14 13/-		
								7B7 .. 7/6	30L15 15/-		
								7C5 .. 10/-	30L17 15/-		
								7C6 .. 7/-	30P12 8/-		
								7C7 .. 6/-	30P19 13/-		
								7F8W 12/6	30PL1 15/-		
								7H7 .. 7/3	30PL13 15/-		
								7Q7 .. 7/-	30PL14 15/-		
								787 .. 18/-	35L6GT 7/-		

										35T .. 17/6	2051 .. 5/-
										35W4 5/-	4043C 35/-
										35Z3 .. 10/-	4313C 20/-
										35Z4GT 8/-	5676 .. 10/-
										35Z5GT 6/-	5678 .. 10/-
										37 .... 4/-	5704 .. 9/-
										38 .... 4/-	5726 .. 7/-
										42 .... 5/-	6060 .. 5/6
										50CD6G 27/6	6064 .. 7/-
										50L6GT 8/-	6065 .. 9/-
										53A .. 7/6	6080 .. 32/-
										57 .... 6/-	6146 .. 25/-
										58 .... 6/-	7193 .. 1/9
										59 .... 6/-	7475 .. 2/-
										75 .... 5/6	8013A 25/-
										76 .... 5/-	8020 .. 15/-
										77 .... 6/6	9001 .. 3/-
										78 .... 5/-	9002 .. 4/6
										80 .... 5/6	9003 .. 6/-
										81 .... 5/-	9004 .. 2/6
										84 .... 5/-	9006 .. 2/6
										85A2 .. 8/-	C.R. Tubes
										210VPT	£4504/B/16
										7-pin 2/6	28/-
										215SG 6/-	09J .. 75/-
										220PA 7/-	VCR97 28/-
										220TH 4/-	VCR139A
										295DU 9/-	30/-
										282A £5	VCR51750/-
										307A .. 5/6	VCR517B
										313C .. 25/-	55/-
										357A .. 70/-	VCR517C
										368AS 30/-	60/-
										393A .. 27/6	3EG1 40/-
										446A .. 8/-	2FP7 25/-
										703A 30/-	5CP1 30/-
										705A .. 10/-	8BD 80/-
										715B .. 50/-	6FP7 12/6
										717A .. 5/-	Photo Tubes
										803 .. 22/6	G816 12/6
										807 .. 3/-	931A 62/6
										808 .. 3/-	6097C 350/-
										813 .. 75/-	Special
										815 .. 35/-	Valves
										829B .. 50/-	ACT6 .. £8
										830B .. 4/-	CV1031
										832A .. 45/-	£3/10/-
										843 .. 5/-	CV2339 £20
										866A .. 14/-	K301 .. £4
										884 .. 10/-	KRN2A
										954 .. 4/6	£3/10/-
										955 .. 2/6	1B24 25/-
										956 .. 2/-	2J22 £2/10/-
										957 .. 5/-	WL417A
										958A .. 4 -	30/-
										1616 .. 3/-	3J/92 E
										1619 .. 5/-	£37/10/-
										1625 .. 6/-	714AY £4
										1626 .. 3/-	725A £5
										1629 .. 4/6	726A 19/-

TRANSISTORS

OC16 .. 20/-	OC81D 3/6	OC202 13/-	XC142 15/-	
OC22 .. 22/-	OC81M 5/-	OC203 10/6	XC155 12/6	
OC25 .. 9/6	OC82 8/-	OC204 15/-	NC156 15/-	
OC35 .. 12/6	OC82DM 3/6	OC206 15/-	2N247 9/6	
OC44 .. 4/6	OC83 .. 5/-	AAZ12 6/-	2N412 7/6	
OC45 .. 3/6	OC83B 5/-	AC128 4/6	2N502 19/6	
OC71 .. 4/6	OC122 5/-	BCZ11 7/6	2N585 10/6	
OC72 .. 5/-	OC170 5/6	BY38 7/6	2N1090 7/6	
OC73 .. 8/6	OC200 7/6	XC141 10/-	2N1091 9/6	
OC81 .. 5/-	OC201 8/-			

E3 .... 8/-	UL84 5/6	1S4 .. 5/-	6AK7 6/-	
R10 .. 5/6	UP41 4/-	1S5 .. 4/6	6AK8 5/9	
EG1-240A	UU5 .. 7/-	1T4 .. 3/-	6AL5 3/-	
25/-	UU9 .. 8/6	2A3 .. 5/-	6AL5W 7/-	
RK72.. 6/-	UY21 7/6	2C26 .. 5/-	6AM5 2/6	
S23.... 7/-	UY41 6/8	2C26A 7/-	6AM6 4/-	
SP2 .. 3/6	UY85 5/-	2C34 .. 7/-	6AQ5 7/-	
SP41 .. 1/6	V1507 5/-	2C46 .. 30/-	6AQ5W 9/-	
SP61 .. 4/-	VP23 .. 2/6	2C51 .. 13/-	6AS6 4/-	
SP210 3/6	VP133 9/-	2D21 .. 5/-	6AS7G 15/-	
STV280/40	VR99 7/6	2X2 .. 3/-	6AT6 .. 4/-	
24/-	VR150,30	3A4 .. 4/-	6AU6 6/-	
SU2150A	5/-	3A108A 35/-	6AX4 8/-	
10/-	VU39 8/-	3A146J 55/-	6B7 .. 5/-	
S11E12 10/-	VX3208 5/-	3A167M 55/-	6B4G 17/-	
TD04-20	VX8122 5/-	3B7 .. 5/-	6B8G 2/6	
70/-	VX8124 5/-	3B24 .. 9/-	6BA6 5/-	
TP22 .. 5/-	W21 .. 5/-	3D6 .. 4/-	6BA7 5/-	
TP25 .. 15/-	W118 8/-	3E29 .. 50/-	6BE6 4/6	
TT11 .. 5/-	E119 9/-	3Q4 .. 6/-	6BJ6 .. 7/6	
TT15 .. 35/-	X65 .. 5/-	3Q5GT 7/6	6BJ7 .. 7/-	
TTR31 45/-	X66 .. 7/6	3S4 .. 5/-	6BW6 8/-	
TZ40 40/-	X76M 10/-	3V4 .. 5/9	6BQ7A 8/-	
TZ0502 4/-	X81M 18/-	4C27 .. 35/-	6BR7 9/-	
TZ20 .. 16/-	X118 .. 8/-	4D1 .. 4/-	6BR8 5/-	
U81 .. 8/-	X145 .. 8/-	5A173G 5/-	6BW6 7/-	
U12/14 8/-	Y63 .. 5/-	5A174G 5/-	6BW7 10/-	
U17 .. 5/-	Y65 .. 4/-	5B251M 40/-	6C4 .. 6/-	
U18 .. 6/-	Z246A/1K	5B252M 35/-	6C5G 2/6	
U25 .. 13/-	190/-	5B254M 40/-	6C6GT 6/-	
U26 .. 13/-	Z800U 20/-	5B/255M	6C6 .. 4 -	
U27 .. 8/-	Z801U 10/-	35/-	6C8G .. 3/-	
U52 .. 4/6	Z900T 12/-	5R4GY 9/-	6C21 .. 80/-	
U191 .. 11/6	1A3 .. 3/-	5T4 .. 7/-	6CH6 .. 4/6	
U801 .. 17/-	1A5GT 5/-	5U4G 4/6	6CL6 .. 9/-	
UABC80 6/-	1B22 30/-	5V4G 8/6	6CW4 12/-	
UBC41 8/-	1D8GT 6/-	5X4G 8/6	6D6 .. 3/-	

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. P. & P. up to 10/- 1/-; 10/- to £1 2/-, over £1 2/- in £, over £3 post free. C.O.D. 4 - extra.

RADIO FREQ. THERMO-COUPLE METER
350 mA. 2in. round plug-in 14/6
1 amp. 2½in. round proj. 17/6
P. & P. 3/- each.

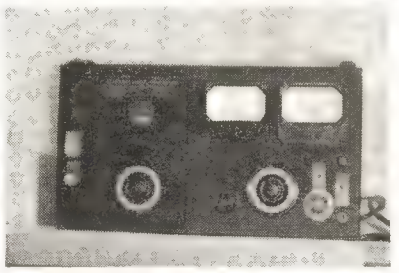
D.C. MOVING COIL METERS
50μA. 2½in. round proj. 25/-
200μA. 2in. round panel, sealed calibro-30 .. 22/6
200 μA. 3½in. round panel 32/6
750-0-750 μA. 2in. round plug-in 20/-
1 mA. 2½in. round clip fix, metal clad 27/6
1 mA. 2½in. round panel 30/-
1 mA. 2in. round panel sealed 27/6
1 mA. 3½in. round panel 30/-
5 mA. 2in. round clip-fix panel or proj. 20/-
5-0-5 mA. 1½in. round panel 17/6
10-0-10 mA. 2½in. round panel 17/6
0-30 mA. 2½in. round panel 17/6
75 mA. 2½in. plug in 14/-
100 mA. 1½in. proj. 17/6
100 mA. 1½in. round panel 17/6
100 mA. 2½in. square panel 19/-
100 mA. 3½in. round panel 25/-
2 amp. 2½in. round panel 22/6
5-0-5 amp. 2½in. round panel 25/-
8 amp. 2½in. round panel 25/-
25 amp. 3½in. round proj. 27/6
50 amp. 2½in. round panel 27/6
20 VDC 2in. square panel 19/-
150 VDC 4in. round panel 25/-
1.5 KV with res 2in. round panel 27/6
0-1500v. 2½in. electst. plug in, round panel .. 30/-

MOVING IRON METERS
15 VAC 2½in. round panel 27/6
500 VAC 2½in. round clip fix 25/-

P. C. RADIO LTD.
170, GOLDHAWK RD., W.12
SHEpherd's Bush 4946

Open 9-5.30 p.m. except Thursday 9-1 p.m.

ALL TEST & COMMUNICATION EQUIPMENT has been thoroughly prepared in our Laboratories by fully qualified Electronic Engineers.



BOONTON STANDARD SIGNAL GENERATOR MODEL 80. Frequency 2-400 Mc/s in 6 ranges. A.M., 400 and 1,000 c/s. and external modulation. Provision for pulse modulation. Piston type attenuator 0.1Vμ-100mV. Separate meter for modulation level and carrier level. Precision flywheel tuning. 117 v. A.C. input with instruction manual, **£95.** Carriage 30/-.

MARCONI SIGNAL GENERATOR TYPE TF 144G. 85 kc/s.-25 Mc/s. Excellent laboratory tested condition, with all necessary accessories with instruction manual, **£45.** P. & P. 15/-.

H.R.O. SENIOR RACK MODEL TYPE M. 50 kc/s.-30 Mc/s. with "S" meter and crystal filter in excellent fully checked and tested condition together with set of 9 general coverage coils and mains P.S.U. 110-220 .v **£28.** Carriage and packing 30/-.

COMPLETE V.F.O. UNIT from TX53. Freq range in 4 switched bands from 1.2-17.5 Mc/s. Two V.T. 501s as oscillator and buffer. 807 as driver, two 5i30s as voltage stabilizers. Output sufficient to drive two 813s in parallel. Slow motion drive directly calibrated in Mc/s. Provision for crystal control, metering of buffer and driver stage. Power requirements 400 v. and 6.3 v. D.C. Can also be used as low power transmitter. In excellent condition with valves and circuit diagram. **£5/19/6.** P. & P. 15/-.

C.R.100 RECEIVER. 60 kc/s. 420 kc/s., 500 kc/s.-30 Mc/s. in 6 bands, 2 HF stages, 3 IF stages, AVC on both phone and CW. Excellent condition, correctly tuned and guaranteed, **£31.** Carriage 30/-.

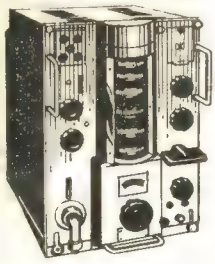
29/41FT. AERIALS each consisting of ten 3ft., ⅞in. dia. tubular screw-in sections. 11ft. (6-section) whip aerial with adaptor to fit the 7in. rod, insulated base, stay plate and stay assemblies, pegs, reamer, hammer, etc. Absolutely brand new and complete ready to erect, in canvas bag, **£3/9/6.** P. & P. 10/6.

SIGNAL GENERATOR TYPE TS 418. Signal frequency 400-1,000 Mc/s. direct calibration. Pulse rate 40-400 c (X1 or X10), pulse delay variable, less than 3μsec to more than 300μsec. Pulse width variable less than 1μsec. to more than 10μsec. Polarity—internal or external sources, positive or negative pulses, AM & CW. Output attenuator 0.2μV to 200mV continuously variable. In fully tested condition, **£150.** Carriage paid.

R.C.A. U.H.F. SIGNAL GENERATOR 710A Output frequency 370 to 560 M/cs. Output voltages 1μv to 90mv. Directly calibrated in megacycles (.5% accuracy). 400 cycles internal modulation, external modulation up to 1 Mc/s. may be applied by means of the input cable supplied with the instrument. Power supply 105/125 v. In excellent condition and guaranteed **£42/10/-.** Carriage 30/-.

MINIATURE MULTIMETER TYPE ITI—2. D.C. voltage 0-2. 45 kV. (20,000 ohms per volt). A.C. voltage 0-1000 v. (10,000 ohms per volt). D.C. current 0-250mA. Resistance 0-6 megohms. Capacitance 10pf. to .1mfd. Decibels 20 to + 22db. Dimensions 4½" × 3½" × 1". Price **£3/16/6.** P. & P. 3/6.

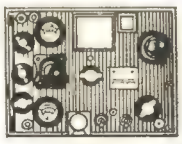
PERSONAL CALLERS WELCOME



ADMIRALTY B.40 RECEIVERS

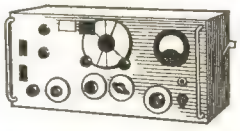
Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s.-30 Mc/s. I/F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O. calibrator, L.F. output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19½in. × 13½in. × 16in. Weight 114 lbs. Offered in good working condition, **£22/10/-**, Carr. 30/-. With circuit diagrams. Also available B41 L.F. version of above. 15 Kc/s-700 Kc/s, **£17/10/-**, carr. 30/-.

COLLINS TCS TRANSMITTERS



Frequency range 1.5-12 Mc/s. in 3 bands. Employ 7 valves, 2 or 1625 PA, 1625 Buffer, 1625 Mod., 3×12 A6 Osc. R.T. or C.W. V.F.O. or provision for Xtals, incorporate plate and aerial-current meters. Require ext. P.S.U. Offered in excellent condition. **£8/19/6.** carr. 15/-.

MARCONI TEST EQUIPMENT



AS NEW CURRENT EQUIPMENT

TF. 142F	DISTORTION FACTOR METER	£75
TF. 675E/1	PULSE GENERATORS	£45
TF. 1065/1	OUTPUT TEST SET	£40
TF. 1067	FREQUENCY METER	£75
TF. 1067/4	FREQUENCY METER	£75
TF. 1073/A/4	ATTENUATOR	£25
TF. 1100	SENSITIVE VALVE VOLTMETER	£50
TF. 1400	PULSE GENERATOR	£75
TF. 1382	L.F. GENERATOR	£75
T.F. 1389	NANOSECOND PULSE GENERATOR	£60
TF. 1342	LOW CAPACITANCE BRIDGE	£45

EX-MILITARY RECONDITIONED

TF. 114G **STANDARD SIGNAL GENERATOR** 85kc/s-25Mc/s. 200/250V. A.C. **£25.** CARR. 20/-.

TF. 329G "Q" METER. BRAND NEW COMPLETE WITH ALL ACCESSORIES. **£75.** CARR. 30/-.

TF. 195M BEAT FREQUENCY OSCILLATOR. 0-40 kc/s., 200/250V. A.C. **£20.** Carr. 30/-.

All above offered in excellent condition fully tested and checked.

R.C.A. AR88 SPEAKERS

8in., 3 ohm speakers in metal case. Black crackle finish to match our 88 Receivers. Available Brand New and Boxed with leads. 59/6. Carr. 7/6.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands. Directly calibrated. Variable R.F. attenuator. Operation 200/240 v. A.C. Brand new with instructions **£12/10/-**. P. & P. 7/6. S.A.E. for details.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 PF - 2,000 MFD. 2 ohms 200 megohms. Also checks impedance turns ratio, insulation, 200/250 v. A.C. **Brand New, £15.** Carr. 7/6.

TE-45 VALVE VOLTMETER

High quality instrument with 28 ranges.
D.C. volts 1.5-1,500 v.
A.C. volts 1.5-1,500 v.
Resistance up to 1,000 megohms.
220/240 v. A.C. operation.
Complete with probe and instructions. **£15.** P.P. 5/-.
Additional Probes available: R.F. **35/-**; H.V. **42/6.**

T.E. HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: .01 / .003 / .1 / .3 / 1 / 3 /10/30 /100/300 v. R.M.S. 4 cps-1.2 Mc/s. Decibels −40 to +50 dB. Supplied brand new complete with leads and instructions. Operation 230 v. A.C. **£17/10/-.** Carr. 5/-.

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼in. dia. shafts. Bulk quantities available.

25 WATT. 10/25/50/100/250/500/1000/1500/2500 or 5000 ohms, **14/6.** P. & P. 1/6.

50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, **21/-.** P. & P. 1/6.

100 WATT. 1/3/10/25/50/100/250/500/1000 or 2500 ohms, **27/6.** P. & P. 1/6.

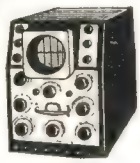
TYPE 13A DOUBLE BEAM OSCILLOSCOPES BARGAIN

A high quality instrument offered at a fraction of original cost. Timebase 2 c/s-750 kc/s. Separate Y1 and Y2 amplifiers up to 5.5 Mc/s. Built-in calibrators at 100 kc/s. and 1 Mc. Operation for 115 / 250 v. A.C. Available in excellent condition, fully tested and checked. **£22/10/-.** Carr. 30/-.

OTHER SCOPES AVAILABLE

SOLARTRON CD.513.2	£45
SOLARTRON CD.523/2	£45
MULLARD L.101	£55
E.M.I. W.M.Z	£50
SOLARTRON CD.711S/2	£75
EMI WM.5	£65

COSSOR 1035 Mk. III DOUBLE BEAM OSCILLOSCOPES



A limited supply of these latest improved oscilloscopes now available in excellent condition. Use miniature valves and are much lighter than older models. Fully guaranteed. **£45.** Carr. 30/-. Also available Mk. I **£35.** Carr. 30/-.

DUMONT 7YP2 C.R.T.

5 gun, 5" square face
BRAND NEW £5/19 6. Carr. 5/-.

B.C.221 FREQUENCY METERS

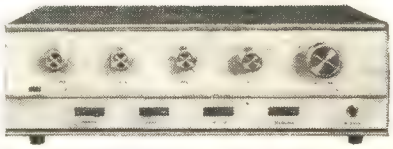
125 kc/s.-20 Mc/s. Offered in excellent condition complete with all valves, crystal and original charts. **£30.** Carr. 20/-.

TWO-WAY RADIOS

SUPERB QUALITY, BRAND NEW & GUARANTEED

3 TRANSISTORS **£6/15/-** PAIR.
4 TRANSISTORS **£7/19/6** PAIR.
5 TRANSISTORS **£8/4/-** PAIR.
6 TRANSISTORS **£9/19/6** PAIR.
6 TRANSISTOR DE-LUXE LAFAYETTE **£17/10/-** PAIR.
10 TRANSISTOR **£22/10/-** PAIR.
13 TRANSISTOR 500 MW 2-channel **30 gns.** PAIR.
13 TRANSISTOR 1 WATT 2-channel **£35** PAIR.
POST EXTRA.

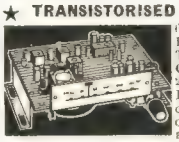
LAFAYETTE HI-FI SOLID STATE STEREO AMPLIFIERS



Latest 1967 models now available. Outstanding performance from modern semi-conductors. Provision for all types of inputs and outputs and comprehensive tone controls. Attractive metal cased free standing units.

Model LA-224T. 30 watt **£25** Carr.7/6
Model LA-60T. 60 watt **£37/10/-.** Carr. 7/6. (U.S.A. Ratings.) Details on request.

★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER SIZE ONLY 6in.×4in.×2½in. 3 I.F. stages. Double tuned discrimination, ample output to feed most amplifiers. Operates on 9 volt battery. Coverage 88-108 Mc/s. Ready built ready for use. Fantastic value for money.

£6.17.6 P. & P. 2/6.

LAFAYETTE HI-FI STEREO HEAD PHONES

★ Air cushioned headband
★ Soft rubber ear pads
★ Frequency response, 25 to 15,000 cycles. ★ High sensitivity. Impedance 8 ohms per phone. Supplied complete with all cables, wires, overhead junction box and 3-connection plug. **79/6.** P. & P. 2/6.

SILICON RECTIFIERS

200 v. P.I.V. 200 mA.	2/6
200 v. P.I.V. 6 amp.	5/6
400 v. P.I.V. 3 amp.	5/6
1,000 v. P.I.V. 650 mA.	6/6
800 v. P.I.V. 400 mA	5/6
400 v. P.I.V. 500 mA	3/6
800 v. P.I.V. 5 amp.	7/6
70 v. P.I.V. 1 amp.	3/6
150 v. P.I.V. 165mA	1/-
700 v. P.I.V. 100 amp.	49/6
150 v. P.I.V. 25 amp.	19/6
700 v. P.I.V. 100 amp.	49/6
150 v. P.I.V. 25 amp.	19/6

Discount for quantities. Post extra.

THYRISTORS SILICON CONTROL RECTIFIERS

400 P.I.V. 3 amp.	10/-
100 P.I.V. 5 amp.	13/6
200 P.I.V. 5 amp.	15/6
400 P.I.V. 5 amp.	17/6

S.T.C. 1 WATT ZENER DIODES

BRAND NEW, LIST 17/6 each.
Available 2.4/2.7/3/3.9/4.3/13/16/18/20 30/33 volts. **5/-** each type. P. & P. extra.

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid.
High quality construction. Input 230 v. 50-60 cycles.
Output full variable from 0-260 volts. Bulk quantities available.
1 amp.—**£4/10/-**; 2.5 amp.—**£5/17/6**; 5 amp.—**£9**; 8 amp.—**£13/10/-**; 10 amp. **£17**; 12 amp.—**£19/10/-**; 20 amp.—**£32/10/-**.

AMERICAN RECORDING TAPES

First grade quality American tapes. Brand new and guaranteed. Discounts for quantities.

3in.	225ft. L.P. Acetate	4/-
3½in.	600ft. T.P. Mylar	10/-
5in.	600ft. Std. plastic	8/6
6in.	900ft. L.P. acetate	10/-
5in.	1,200ft. D.P. Mylar	15/-
5in.	1,800ft. T.P. Mylar	35/-
5½in.	1,200ft. L.P. acetate	12/6
5½in.	1,800ft. D.P. Mylar	22/6
5½in.	2,400ft. T.P. Mylar	45/-
7in.	1,200ft. Std. acetate	12/6
7in.	1,800ft. L.P. acetate	15/-
7in.	1,800ft. L.P. Mylar	20/-
7in.	2,400ft. D.P. Mylar	25/-
7in.	3,600ft. T.P. Mylar	58/6

Postage 2/-. Over £3 post paid.

MAGNAVOX 363 TAPE DECKS

3 speed. 1⅞-3¾-7½ ips. Carr. paid. 2-track **£10/10/-**; 4-track **£13/10/-**; 2-track Stereo **£13/10/-**.

RECORDING HEADS

Reuter ¼-track. As fitted to Collaro Mk. IV and Studio Decks. High imp. record play back, low imp. erase. Brand new, **19/6** pair. **MINIFLUX** ¼-track, set of 3, **29/6. Bradmatic** ¼-track, set of 2, **92/6.** Post ex.

MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A B and Ico. Equally adjustable for checking diodes, etc.
Spec.: A: 0.7-099.67.
B: 5-200.
Ico: 0-50 microamps. 0.5mA.
Resistance for diode 200Ω −1 MEG. Supplied complete with instructions, battery and leads. **£5/19/6.** P. & P. 2/6.

F.M. WIRELESS MICROPHONE

94-104 Mc/s. Transistorised Operates from 9 v. battery Complete with additional secret tie-clip microphone. List £12/10/-. **ONLY £8.15/-.** P. & P. 2/6.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

Operative over amazingly long distances. Separate call and press to talk buttons. 2-wire connection. 1000s of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. **£5/19/6** pair. P. & P. 3/6.

SINCLAIR AUDIO EQUIPMENT

Z12 amplifier, **89/6**; PZ3 P.S.U. **79/6**; Stereo 25 pre-amp. **£9/19/6**; MICRO FM TUNER KIT, **£5/19/6**; MICRO 6 RADIO KIT, **59/6**. MICROMATIC RADIO KIT, **59/6**. READY BUILT, **79/6**. All post paid.

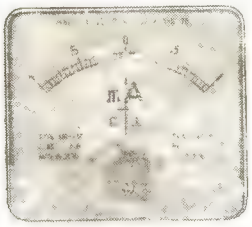
G. W. SMITH & Co. (Radio) Ltd.

3-34, Lisle St., W.C.2.
ALSO SEE OPPOSITE PAGE

SEW PANEL METERS

Send S.A.E. for full lists. Other ranges available. Please include postage. Special quotations for quantities.

CLEAR PLASTIC METERS



Type MR.38P. 1 31/32in. square fronts.

50μA	32/6	5 amp	22/6
50-0-50μA	29/6	3V. D.C.	22/6
100μA	29/6	10V. D.C.	22/6
100-0-100μA	27/6	20V. D.C.	22/6
200μA	27/6	50V. D.C.	22/6
500μA	25/-	150V. D.C.	22/6
500-0-500μA	22/6	300V. D.C.	22/6
1mA	22/6	150V. A.C.	22/6
1.0.1mA	22/6	40V. A.C.	22/6
5mA	22/6	150V. A.C.	22/6
10mA	22/6	300V. A.C.	22/6
50mA	22/6	500V. A.C.	22/6
100mA	22/6	8 meter 1mA	29/6
500mA	22/6	VU meter	35/-
1 amp	22/6		

Type MR.45P 2in. square fronts.

50μA	39/6	20V. D.C.	25/-
50-0-50μA	35/-	50V. D.C.	25/-
100μA	35/-	300V. D.C.	25/-
100-0-100μA	32/6	15V. A.C.	25/-
500μA	27/6	300V. A.C.	25/-
1mA	25/-	8 meter 1mA	35/-
5mA	25/-	VU meter	39/6
10mA	25/-	1 amp. A.C.*	25/-
50mA	25/-	5 amp. A.C.*	25/-
100mA	25/-	10 amp. A.C.*	25/-
1 Amp.	25/-	20 amp. A.C.*	25/-
5 amp.	25/-	30 amp. A.C.*	25/-
10V. D.C.	25/-		

Type MR.52P. 2¾in. square fronts.

50μA	57/6	10V. D.C.	32/6
50-0-50μA	57/6	20V. D.C.	32/6
100μA	47/6	50V. D.C.	32/6
100-0-100μA	47/6	300V. D.C.	32/6
500μA	37/6	15V. A.C.	32/6
1mA	32/6	300V. A.C.	32/6
5mA	32/6	8 Meter 1mA	39/6
10mA	32/6	VU Meter	55/-
50mA	32/6	1 amp. A.C.*	32/6
100mA	32/6	5 amp. A.C.*	32/6
500mA	32/6	10 Amp. A.C.*	32/6
1 amp.	32/6	20 amp. A.C.*	32/6
5 amp.	32/6	30 amp. A.C.*	32/6

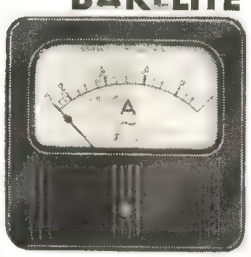
Type MR.85P. 4½in. × 4½in. fronts.

50μA	69/6	15 amp.	45/-
50-0-50μA	69/6	30 amp.	45/-
100μA	59/6	10V. D.C.	45/-
100-0-100μA	59/6	20V. D.C.	45/-
200μA	55/-	50V. D.C.	45/-
500μA	49/6	150V. D.C.	45/-
500-0-500μA	49/6	300V. D.C.	45/-
1mA	45/-	15V. A.C.	45/-
1.0.1mA	45/-	300V. A.C.	45/-
5mA	45/-	VU meter	69/6
10mA	45/-	1 amp. A.C.*	45/-
50mA	45/-	5 amp. A.C.*	45/-
100mA	45/-	10 amp. A.C.*	45/-
500mA	45/-	20 amp. A.C.*	45/-
1 amp.	45/-	30 amp. A.C.*	45/-
5 amp.	45/-		

Type MR.65P. 3½in. × 3½in. fronts.

50μA	59/6	20V. D.C.	35/-
50-0-50μA	59/6	50V. D.C.	35/-
100μA	49/6	150V. D.C.	35/-
100-0-100μA	49/6	300 V. D.C.	35/-
500μA	39/6	15V. A.C.	35/-
1mA	35/-	50V. A.C.	35/-
5mA	35/-	150V. A.C.	35/-
10mA	35/-	300V. A.C.	35/-
50mA	35/-	500V. A.C.	35/-
100mA	35/-	VU meter	59/6
500mA	35/-	1 amp. A.C.*	35/-
1 amp.	35/-	5 amp. A.C.*	35/-
5 amp.	35/-	10 amp. A.C.*	35/-
15 amp.	35/-	20 amp. A.C.*	35/-
30 amp.	35/-	30 amp. A.C.*	35/-
00V. D.C.	35/-		

BAKELITE PANEL METERS



Moving iron, all others moving

Type MR.65. 3½in. square fronts.

25μA	65/-	50 amp.	29/6
50μA	42/6	5V. D.C.	29/6
50-0-50μA	42/6	10V. D.C.	29/6
100μA	39/6	20V. D.C.	29/6
100-0-100μA	39/6	50V. D.C.	29/6
500μA	35/-	150V. D.C.	29/6
500-0-500μA	35/-	300V. D.C.	29/6
1mA	29/6	30V. A.C.*	29/6
1.0.1mA	29/6	50V. A.C.*	29/6
5mA	29/6	150V. A.C.*	29/6
10mA	29/6	300V. A.C.*	29/6
50mA	29/6	1 amp. A.C.*	29/6
100mA	29/6	5 amp. A.C.*	29/6
500mA	29/6	10 amp. A.C.*	29/6
1 amp.	29/6	20 amp. A.C.*	29/6
5 amp.	29/6	30 amp. A.C.*	29/6
15 amp.	29/6	50 amp. A.C.*	29/6
30 amp.	29/6	VU meter	49/6

MULTIMETERS *for EVERY purpose!*

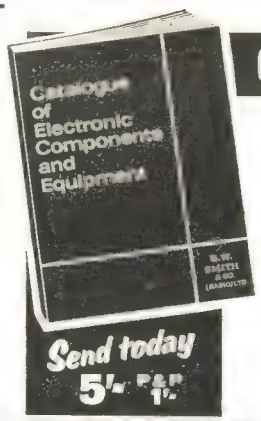
NEW MODEL 500, 30,000 O.P.V. with overload protection, mirror scale. 0/.5 / 2.5 / 10 / 25 / 100 250/500/1,000 v. D.C. 0/2.5/ 10 / 25 / 100 / 250 / 500 / 1,000 v. A.C. 0/50μA/5/50/ 500 mA. 12 amp. D.C. 0/60/K6. Meg./60. Meg. Ω **£8/17/6.** Post paid.

MODEL TE.80 20,000 O.P.V. 0/10/50/100/500/1,000 v. A.C. 0/5/25/50/250/500/ 1,000 v. D.C. 0-50μA 5/50/500mA. 0/6K/60K/600 K/6 meg. **£4/17/6.** P.P. 3/-

TE-900 20,000Ω/VOLT GIANT MULTIMETER 6in. full view meter. 2 colour scale. 0/2.5/10/ 250/1,000/5,000 v. A.C. 0 / 25 / 12.5 / 10 / 50 / 250/1,000/5,000 v. D.C. 0/50μA/110/100/500 mA/ 10 amp. D.C. 02K/ 200K / 20 MEG. OHM. **£12/19/6.** P. & P. 5/-.

MODEL U50D. WITH METER PROTECTION. 20,000 o.p.v. 0/.1/.5/5/50/250/1,000 v. D.C. 0/2.5/10/50/250/1,000 v. A.C. 0/50/.5/5/50/250 mA. 0,5K/ 50K/500K/5 meg. Ω. .0001—.2 mfd. —20 —22 dB. **£5 15/-.** P. & P. 3/-.

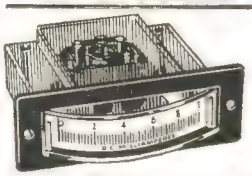
MANY OTHER MODELS AVAILABLE FROM AS LOW AS 39/6.



CATALOGUE

★ ELECTRONIC COMPONENTS
★ TEST EQUIPMENT
★ COMMUNICATION EQUIPMENT
★ HI-FI EQUIPMENT

We are proud to introduce our first comprehensive catalogue of Electronic Components and Equipment. Over 150 pages, fully illustrated, listing thousands of items, many at bargain prices. Free discount coupons with every catalogue. Everyone in electronics should have a copy.

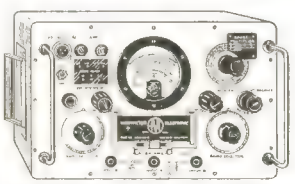


NEW RANGE OF "SEW" EDGEWISE METERS

MODEL PE.70. Dimensions 3 17/32in. × 1 31/32 × 2¼ in deep overall. Available as follows:

50 microamp	52/6	500 microamp	42/6
50-0-50 microamp	49/6	1 milliamp	39/6
100 microamp	49/6	300 volt A.C.	39/6
100-0-100 microamp	45/-	VU meter	55/-
200 microamp	45/-	Post extra.	

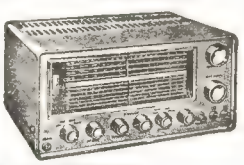
AVO CT.38 ELECTRONIC MULTIMETERS

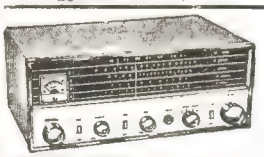


High quality 97 range instrument which measures A.C. and D.C. Voltage. Current, Resistance and Power Output. Ranges: A.C. and D.C. volts 100 mV. to 250 V.; A.C. and D.C. current 10 μA-1 amp.; watts, 50μW to 5 W.; Resistance 0-200 MΩ. Incorporates automatic protection against overload. Operation 0/110/200/250 v. A.C. Supplied in perfect condition complete with circuit, lead and R.F. probe **£25.** Carr. 15/-. **AVO CALIBRATION TEST UNIT TYPE CT.155.** For use with CT.38 Multimeter. Gives 7 standard voltages 250 mV./1 v./ 2.5 v./10/25/100 v. A.C. and 250 millivolts D.C. from internal standard cell. Operation 0/110/200/250 v. A.C. Brand new **£7/10/-.** P. & P. 10/6.

LAFAYETTE KT340 COMMUNICATIONS RECEIVER—SEMI KIT

Build this wonderful receiver and save pounds. Supplied semi-completed, main components ready mounted. RF section already wired and aligned. Full and precise instructions supplied. Specification 8 valves+rectifier, 4 bands covering 550 kc/s. 30 Mc/s. Incorporates 1 RF and 2 IF stages. "Q" multiplier. BFO, ANL, "S" meter, bandspread, aerial trimmer, etc. Operates 115/230 v. A.C. PRICE **25 GNS.** Carr. 10/-.





HAM-I. 4 BAND COMMUNICATION RECEIVER

4 wavebands covering 535 Kc/s-30 Mc/s., 5 valve superhet circuit. Incorporates S meter. BFO BANDSPREAD TUNING, BUILT-IN 4in. SPEAKER, FERRITE AERIAL & EXTERNAL TELESCOPIC AERIAL. Operation 200/ 140 v. A.C. Supplied brand new with handbook NOW **£15/15/-.** Carr. 10/-.

NEW LAFAYETTE HA700 AM/CW/SSB AMATEUR COMMUNICATION RECEIVER

8 valves, 5 bands incorporating 2 MECHANICAL FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150-400 Kc/s. 550-1,600 Kc/s. 1.6-4.0 Mc/s. 4.8-14.5 Mc/s. 10.5-30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter, B.F.O. product detector, electrical bandspread, S meter slide rule dial. Output for phones, low to 2KΩ or speaker 4 or 8 ohms. Operation 220/240 volt A.C. Size 7¾in. × 15in. × 10in. Supplied brand new and guaranteed with handbook. **36 gns.** Carr. 10/-. S.A.E. for leaflet.

LAFAYETTE MODEL HA-500 3SB/AM/CW 80 THROUGH 6 METRE RECEIVER

New outstanding Ham Bands only receiver covering the 80/40/20/15/10/6 metre bands. Incorporates 10 valves, product detector, two mechanical filters, S Meter, dual conversion on all bands, crystal calibrator, B.F.O. noise limiter, aerial trimmer, I.F.'s 2,608 Mc/s. and 455 Kc/s. Output 8 ohms and 500 ohms. Operations 220/240 volt A.C. Supplied brand new and guaranteed with handbook. **42 Gns.** Carr. 10/-. 100 Kc/s. crystal, **35/-.**

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

OPEN 9 a.m. to 6 p.m. every day Monday to Saturday. Trade supplied.

WW—140 FOR FURTHER DETAILS

Z AND AERO SERVICES LTD

PEN RECORDERS

Elliot portable recording milliammeters.
As D.C. recorder: 1 mA. FSD. Movement resistance 1200Ω.
As A.C. current or voltage recorder: Movement resistance at 50 c/s, 1800Ω. Sensitivity 1 mA. A.C. FSD.
As decibel meter: source impedance 600Ω. Range +5 to −10 dB. Frequency response 50 c/s. to 15 kc/s.
Chart drive: 230 v. A.C. at 1in. and 6in. per hour. Movement is fitted with "high" and "low" alarm contacts which can be set for any value of the current.
Strip chart 3¼in. wide. Curvilinear trace. PRICE £40
Packing and carriage 15/-.

RECORD PORTABLE RECORDING MILLIAMMETERS

These are similar to the above but are somewhat smaller and lighter, and D.C. resistance of the movement is 400Ω. Other details as above. PRICE £42 10
Packing and carriage 15/-.
These are also available as decibel meters. Type 19A/C.T.A. Range + 3/0/ −3dB 6 + with current of 500 μA at 0 dB. Movement resistance 1900Ω £45 0 0

THYRISTORS

Type 3/40, 400 p.i.v., 3 amps., stud mounted; Gate voltage 3.0 v. at 20 mA. 7/6
Blue Spot, 200 p.i.v., 3 amps., stud mounted; Gate voltage 3.25 v. at 120 mA. 12/6
Green Spot, 400 p.i.v., otherwise as above 17/6

TEXAS SILICON FULL-WAVE BRIDGE RECTIFIERS

1B20K10 100 p.i.v. 2 amps., dimensions 1.4 ×1.4×.6in. 25/-
1B40K10 100 p.i.v. 4 amps., dimensions 1.4×1.4×.6in. 30/-
1B100M10, 100 p.i.v. 10 amps., dimensions 2¼×2¼×1in. 85/-
Postage 1/6 per rectifier.

SILICON HALF WAVE POWER RECTIFIERS

1S004 600 p.i.v., 750 mA., wire ended 7/-
1S111 225 p.i.v., 400 mA., wire ended 5/6
1S113 400 p.i.v., 400 mA., wire ended 7/-
1S115 600 p.i.v., 400 mA., wire ended 12/6
BY100 700 p.i.v., 450 mA., wire ended 7/-
BYZ10, see 8L800.
BYZ12, 400 p.i.v. at 6 a., stud mounted 5/-
BYZ13, 200 p.i.v., 6 amps., stud mounted 7/6
BYZ19, reversed polarity version of BYZ13 ..... 7/6
Set consisting of one BYZ13 and one BYZ19 ..... 12/-
DD000, 50 p.i.v., 500 mA., wire ended 5/-
DD006 400 p.i.v., 500 mA., wire ended 6/6
DD058, 800 p.i.v., 500 mA., wire ended 7/6
DD226, 400 p.i.v., 1 amp., wire ended 6/6
OA210, 400 p.i.v., 500 mA., wire ended 6/6
OA211, 800 p.i.v., 400 mA., wire ended 9/6
RS27AF, 600 p.i.v., 100 mA., wire ended 4/-
RS350AF, 700 p.i.v., 3 amps., wire ended 7/6
RS360AF, 840 p.i.v., 3 amps., wire ended 8/6
RS380AF, 1,120 p.i.v., 3 amps., wire ended 10/-
SJ102A, 100 p.i.v., 2.4 A., stud mounted 7/6
SL800, 800 p.i.v., 6 A., stud mounted 9/-

AVALANCHE SILICON RECTIFIERS

Type RAS608AF, 960 p.i.v. at 6 amps. max., stud mounted 10/6

POWER UNITS TYPE 234

19in. rack mounted fully smoothed and fused for 230 v. A.C. input. H.T. output adjustable from 180 v. to 270 v. at 80 mA. by means of primary taps and high-low switch in the secondary winding. L.T. output 6.3 v. A.C. at 4 amps.
Without meter £3 10 0
Packing and carriage, 15/-.

COUNTER TUBES

GR10A—10-way register-indicator tube 45/-.
GC10/4B—bi-directional 10-way computing tube, double pulse, 50/-.
GC10B—scale of ten counter, 35/-.
GC10D—scale-of-ten counter for single pulse operation, 55/-.
GS10D—Bi-directional 10-way selector tube, 55/-.
GS10H—as GS10D but physically small, 40/-.

MULTIMETERS TYPE MF15

A.C. and D.C. voltage ranges: 0-10-50-250-500-1000V.
D.C. current ranges: 500μA-10-100mA.
Resistance ranges: 100MΩ-1MΩ
The meter is also calibrated for Inductance (10-100H), capacity (0.6μF) and output level measurements. Sensitivity 2000Ω V. Accuracy ±2.5% for D.C. and ±4% for A.C. measurements.
Dimensions: 5⅛×3⅛×1⅛in. Price £3/3/-.

ZENER DIODES

230 mW. 5%. 5.6 V. OAZ242, 7/6; 15% 12.0 V. OAZ273 8/-.
250mW. 5%, 60.0 V. BZY11 6/6; 80 V. BZY13 6/6.
260 mW. 5%. 4.7 V. OAZ200 10/-; 5.1 V. OAZ201 9/6.
5.6 V. OAZ202 7/-; 6.2 V. OAZ203 7/-.
6.8 V. OAZ204 7/-; 7.5 V. OAZ205 7/-.
8.2 V. OAZ206 7/-; 9.1 V. OAZ207 9/6.
260mW. 15%. 4.3 V. OAZ208 6/6; 4.7 V. OAZ209 6/6.
6.2 V. OAZ210 6/-; 7.5 V. OAZ211 6/-.
9.1 V. OAZ212 6/6; 12 V. OAZ213 6/6.
400 mW. 10%. 18.0 V. BZY20 7/6.
1W. 5%. 2.4 V. Z2A24CF; 2.7 V. Z2A27CF; 3.0 V. Z2A30CF.
3.6 V. Z2A36CF; 3.9 V. Z2A39F; 15.0 v. Z2A150FC
16.0 V. Z2A160CF.
30.0 V. Z2A300CF; All at 5/6.
20.0 V. ZNB20 9/6.
1.5W. 5%. 3.0 V., Z3B30CF; 27.0 V. Z3B270CF; 30.0 V. Z3B300CF; 33.0 V. Z3B330CF, all at 6/6.
2.25W 10%. 4.25 V. VR425B 6/6.
5.25 W. 10%. 4.25 V., VR425A; 5.75 V. VR575BA; 7 V., VR7A 11 V. VR11A; 13 V. VR13A. All at 8/-.
7.0 W. 5%. 5.6 V., OAZ222 9/6; 6.8 V., OAZ224 10/-.

GERMANIUM POINT CONTACT DIODES

1N34A	4/-	OA10 (Junction)	6/-	OA7	4/-
1N38A	4/-			HG5093	2/-
1N47	6/-	GEX23	1/6	OA47	4/6
1N69	4/6	GEX44	1/6	OA70	2/6
1N72	4/-	GEX54	2/-	OA79	2/3
1N81	4/-	CK708	4/-	OA81	2/-
CG4E	2/-	HG5008	2/-	OA86	3/6
CG10E	1/6	GEX941	4/-	OA90	2/-
CG12E	2/-	GEX942	4/3	OA91	2/3
CG61H	3/-	OA5	4/6	OA95	3/-
CG62H	1/6	OA6	4/-	S917G	2/-

MICROWAVE DIODES

1,000 mc/s: IN25 15/-.
3,000 mc/s: IN21 4/-; IN21B 6/-; IN28 20/-.
6,000 mc/s: C82A (CV103) 5/-; CV101 5/-; CV102 5/-; CV291 12/-.
9,375 mc/s: IN23CR 20/-; C810B 70/-.
12,000 mc/s: C83B 14/-; C84B 35/-; C89B 30/-; CV111 8/-; CV112 8/-; CV2226 30/-; CV2258 40/-; CV2235 100/-; SIM2 (CV2154) 37/6; S1M5 (CV2155) 37/6.
34860 mc/s: VX3136 (CV2391) 65/-.

25-WATTS 210-240V. SOLDERING IRONS

Recently imported extremely attractive and sturdily built soldering irons, with angle bit. Chromium plated steel body and polished wooden handle. No Bakelite or breakable plastics used in construction.
Price 16/-
Spare bits 1/3
Spare heating element 3/-
Handling and postage 2/-.

HEADPHONES

No. 10 Assembly.
Moving Coil Headphones with moving coil Hand Microphone fitted with press-to-talk switch. Rubber earpads. Cord terminated with army type 5-point moulded connector. Low impedance. Brand new, 20/- ea.
Small quantity available of second hand assemblies; checked in perfect order, 8/6 ea. P. & P. 3/6 per set.

CATHODE RAY TUBES

Standard Single Beam General Purpose Oscilloscope Tubes:
2AP1, 2in. screen, 500 V. to 800 V. EHT, focus 125 V., 6.3 v. heaters; overall length 7 1/16 in. USM11 Base .. 40/-
3BP1, 3in. screen, 1,000-1,500 V. EHT, focus 430 V., 6.3 V. heaters; overall length 10 1/16 in. B14A Base 55/-
VCR139A=ACR10; 2¼in. screen, 400-800 V. EHT., focus 135 V.; overall length 7¼in. B12B Base 30/-

Double Gun Double Beam Flat Face High Sensitivity Instrumen Tubes:
4SP7, 4in. screen, 1,000-1,800 V. EHT, 300-600 V. focus; 6.3 V. heaters; overall length 12¼in. Yellow long persistence trace. B12F Base 200/-
4SP31—as above but green trace medium persistence screen 200/-

Double Beam (Split Beam) Instrument Tubes:
O9D, O9G-4½" screen, 1200v EHT, 300v FOCUS, 4.0v Heaters. Green Trace Medium persistance 80/-
O9J - as above but blue screen short persistance, suitable for photography. (Base B12B) 80/-

IGNITRONS TYPE 5551A

For immediate delivery £15 0 0
Special quantity discounts.
Also available types 5552A and 5553A.

SALE OF SURPLUS EQUIPMENT

Miscellaneous item of second hand Test Equipment, oscillators, signal generators, chains, units, relays, components and some types of valves will be available for sale at exceptionally low prices on

SATURDAY, SEPTEMBER 30, 1967
at 44A WESTBOURNE GROVE, LONDON, W2.
From 9 am. to 6 pm.

ONE DAY ONLY

Nearest tube stations: Royal Oak (District), Bayswater (Circle), Queensway (Central)

Zaerix

VALVES FOR EXPORT

PLEASE WRITE FOR EXPORT PRICE LIST LISTING OVER 300 TYPES AT EXTREMELY ATTRACTIVE PRICES.

Head Office:

44a WESTBOURNE GROVE, LONDON, W.2.

Tel: PARK 5641/2/3
Cables: ZAERO LONDON

A.R.B. Approved for inspection and release of electronic valves, tubes, klystrons, etc.

Retail branch (personal callers only)
85 TOTTENHAM COURT RD., LONDON W.2. Tel: LANgham 8403

ZaerX BRAND

Please send all enquiries, correspondence and Mail orders to Head Office

TRANSISTORS

OC16	25/-	OC75	6/-	OC171	6/-	ACY17	8/6	AF124	9/-	BCY30	7/-	GET872	7/3	2N412	3/6
OC23	16/-	OC76	6/-	OC200	7/6	ACY18	5/6	AF125	8/6	BCZ11	10/6	GET875	9/6	2N696	12/-
OC24	17/6	OC77	8/-	OC201	17/6	ACY19	6/6	AF126	8/-	BFY50	6/6	GET880	12/-	2N697	13/-
OC25	9/6	OC78	5/-	OC202	13/6	ACY21	5/-	AF127	9/-	BFY52	6/6	JTX4A	6/6	2N706	3/4
OC26	8/-	OC78D	5/-	OC203	10/6	ACY21	6/-	AF178	12/6	BSY26	8/6	MAT101	8/6	2N763	6/6
OC28	15/6	OC81	5/-	OC204	15/-	ACY22	5/-	AF186	15/-	BSY28	9/6	MAT120	7/9	2N1132	37/-
OC29	14/9	OC81D	5/-	OC205	15/-	AD140	16/-	AFY19	22/6	BSY65	8/6	MAT121	8/6	2N1304	6/-
OC35	12/6	OC83	5/-	OC206	22/6	AD149	16/-	AFZ11	17/-	GET103	8/6	SB240	18/-	2N1756	15/-
OC42	5/-	OC84	5/-	AC107	10/-	AF102	18/-	AFZ12	12/6	GET104	8/-	V30/30P	20/-	2N2068	20/-
OC43	9/-	OC122	14/-	AC125	6/6	AF114	8/-	ASY26	6/6	HET106	16/-	2G309	5/-	28002	20/-
OC44	5/-	OC139	8/-	AC126	6/6	AF115	7/-	ASY28	6/6	GET113	5/-	2G371A	5/-	28004	20/-
OC45	4/6	OC140	10/-	AC127	7/6	AF116	7/-	ASZ20	7/6	GET114	4/-	2G381	5/-	28006	20/-
OC70	5/-	OC141	22/6	AC128	8/-	AF117	6/-	ASZ21	15/-	GET115	8/6	2G403	6/-	28018	60/-
OC71	5/-	OC170	6/-	AC176	7/6	AF118	14/-	BC107	7/-	GET116	12/-	2N410	3/6	28103	25/-
OC72	5/-													28104	32/-
OC73	9/-	AC176 is complementary to AC128; 2N1132 is complementary to 2N697												28731	13/-

NUVISTORS TRIODES

2CW4 (General Purpose, 2v. htrs.)	12/-
6CW4 (General purpose, 6v. htrs.)	12/-
6D84 (Remote cut-off)	15/-
7586 (Medium-Mu)	22/6
7895 (High-Mu)	22/6
Nuvistor bases	2/6

WHEN ORDERING BY POST PLEASE ADD 2/6 IN £ FOR HANDLING AND POSTAGE. NO C.O.D. ORDERS ACCEPTED. IN ORDER TO AVOID DELAYS PLEASE SEND ALL MAIL ORDERS AND CORRESPONDENCE TO OUR HEAD OFFICE AT 44A WESTBOURNE GROVE, W.2, AND NOT TO THE RETAIL SHOP

FULLY GUARANTEED — FIRST QUALITY VALVES

ZaerX BRAND

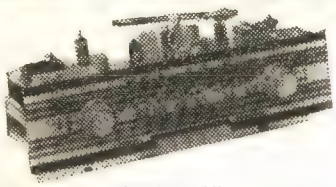
OA2	6/-	6AM8A	8/-	6F13	6/6	7B5	11/-	12SL7GT		50C5	6/-	5684	85/-	AC6/PEN	
OA2WA	9/-	6AN8	10/-	6F14	15/-	7B6	10/-		7/6	50CD6G		5686	25/-		6/-
OB2	6/-	6AQ5	5/6	6F15	11/-	7B7	7/-	12SN7GT	27/6			5687	10/-	AZ1	8/-
OC3	6/-	6AQ6	10/-	6F16	86	7C5	11/-		7/6	50L6GT	6/-	5696	6/-	AZ11	6/-
OD3	6/-	6AR6	6/-	6F18	7/6	7C6	6/6	12SQ7	8/-	53KU	12/6	5702CK	15/-	AZ31	9/-
1A3	4/-	6AS6	6/-	6F19	6/6	7C7	5/-	12SR7	5/-	75	9/-	5725	10/-	AZ41	7/-
1A5GT	5/-	6AS7G	15/-	6F20	10/-	7E5	5/-	12ST7	6/-	75B1	5/6	5726	7/-	B65	5/6
1A7GT	8/-	6AT6	4/6	6F21	2/6	7E6	5/-	12X4	7/-	75C1	13/-	5727	10/-	C1K	70/-
1AX2	10/-	6AU5GT		6F22	6/3	7H7	6/-	12Y4	2/6	76	5/-	5749	10/-	CBL1	15/-
1B3GT	8/-		20/-	6F23	14/-	7K7	10/-	13D1	5/-	80	6/-	5751	12/-	CBL31	15/-
1B35A	25/-	6AU6	5/6	6F25	14/-	7Q7	9/-	13D3	5/-	83A1	12/-	5763	10/-	CCH35	10/-
1B63A	70/-	6AV6	5/-	6F28	13/-	7R7	12/-	13E1	190/-	85A1	25/-	5784	15/-	CY1	8/-
1C5GT	5/-	6AW8A		6F29	6/6	7S7	22/-	14Q7	10/-	85A2	7/6	5814A	10/-	CY31	7/-
1D5	7/6		12/6	6F30	6/6	7Y4	8/-	14S7	18/-	90AG	46/-	5823	13/-	D1	3/-
1G6GT	7/-	6B4G	17/-	6F32	3/-	7Z4	6/-	19AQ5	5/-	90AV	46/-	5840	10/-	DA100	
1H5G	7/-	6B7	5/-	6F33	15/-	8A8	6/3	19G6	15/-	90C1	12/-	5842	65/-		120/-
1H5GT	7/-	6B8	7/-	6G5G	8/-	8D2	3/6	19H1	20/-	90CG	25/-	5881	17/6	DAC32	7/-
1L4	2/6	6B8G	2/6	6G6G	2/6	8D3	4/-	20A1	8/-	90CV	25/-	5899	8/-	DAF91	4/6
1N5GT	8/-	6BA6	4/6	6HU8	13/-	9A8	6/3	20A3	6/-	95A1	5/6	5963	10/-	DAF92	6/-
1R5	6/-	6BF6	4/6	6J4	9/-	9D7	7/-	20D1	9/-	150B2	10/-	5964	10/-	DAF96	6/6
1S4	5/-	6BG6G	15/-	6J5G	4/-	10C14	6/3	20L1	13/-	150B3	8/-	5965	5/-	DCC90	7/-
1S5	4/6	6BH6	7/6	6J6	3/6	10D1	7/-	20P1	12/-	150C2	6/-	6005	7/6	DF66	7/-
1T4	3/-	6BJ6	7/6	6J7G	5/-	10F1	9/-	20P3	12/-	150C3	6/-	6021	12/-	DF72	8/-
1U4	5/-	6BK4	22/6	6K6GT	8/6	10F3	8/-	20P4	13/-	150C4	9/-	6057	10/-	DF96	7/-
1U5	6/-	6BK7A	9/-	6K7	6/-	10L1	7/6	23A6G	5/-	211	30/-	6058	7/-	DH101	7/6
1V2	10/-	6BL7GT		6K7G	2/-	10L14	9/6	25C5	10/-	262B	35/-	6059	18/-	DK32	8/-
1X2B	7/-		10/-	6K8G	4/-	10LD14	6/6	26L6GT	6/6	313C	20/-	6060	5/-	DK40	11/-
2A3	5/-	6BN4	12/-	6K23	7/6	10P13	15/-	25Y5	10/-	506BU	8/-	6061	12/-	DK92	8/-
2C26A	7/-	6BN6	7/6	6L1	10/-	10P14	16/-	25Z4G	8/-	703A	30/-	6064	7/-	DK96	7/-
2C34	7/6	6BN8	8/-	6L6GC	18/-	10P18	6/6	25Z5	8/-	715A	30/-	6067	10/-	DL63	8/-
2C40	65/-	6BQ7A	7/-	6L7	5/-	10PL12	7/3	25Z6GT		715B	60/-	6072	12/-	DL66	20/-
2C42	25/-	6BR7	11/-	6L12	5/-	10Y	15/-		11/-	715C	70/-	6073	9/-	DL75	10/-
2C43	60/-	6BR8	5/-	6L13	6/-	11D3	7/-	28D7W	15/-	721A	10/-	6074	9/6	DL91	5/-
2C46	30/-	6BS7	17/-	6L18	5/-	11D5	7/-	30C15	13/6	724B	15/-	6080	25/-	DL92	5/-
2C51	8/-	6BW6	7/-	6L34	5/-	11E3	55/-	30C17	14/6	803	35/-	6100	10/-	DL93	4/-
2CW4	12/-	6BW7	10/-	6LD12	6/6	12AC6	8/-	30C18	14/-	804	80/-	6101	7/-	DL94	6/-
2D21	6/-	6BX7GT		6LD13	6/3	12AD6	9/-	30F5	14/-	807	9/-	6135	10/-	DL95	7/-
2E26	22/6		15/-	6LD20	9/-	12AE6	7/6	30FL1	15/-	812A	57/6	6136	9/-	DL96	7/-
2X2A	8/-	6BZ6	6/-	6M1	8/-	12AH7GT		30FL12		813	75/-	6146	30/-	DL816	30/-
3A5	7/-	6BZ7	11/-	6M2	13/-		17/-		5/-	815	35/-	6158	9/-	DM70	5/6
3B7	5/-	6C4	4/-	6N7	8/-	12AL5	7/-	30FL13	8/-	829B	60/-	6159	32/-	DM71	6/-
3B28	40/-	6C5G	5/-	6P1	11/-	12AQ5	7/-	30FL14	14/-	832	20/-	6186	10/-	DM160	10/-
3D6	4/-	6C6	4/-	6P25	17/6	12AT6	5/-	30L1	5/6	832A	45/-	6197	20/-	DY70	13/-
3D21A	35/-	6C8G	7/-	6P28	12/6	12AT7	4/-	30L15	15/-	833A	260/-	6203	32/-	DY80	7/-
3Q4	7/-	6CA7	9/6	6Q7	6/-	12AU6	6/-	30L17	15/-	837	17/6	6263	70/-	DY86	6/6
3Q5GT	6/6	6CB6	5/-	6R7	6/-	12AV6	5/8	30P4	13/-	866A	14/-	6264A	70/-	DY87	7/-
3S4	5/-	6CD6GA		6S2	7/-	12AV7	8/-	30P12	13/-	872A	40/-	6293	60/-	DY802	8/-
3V4	6/-		17/-	6S2A	8/-	12AX7	6/-	30P13	10/-	884	15/-	6360	30/-	E55L	50/-
4B32	80/-	6CF8	6/3	6SA7	7/-	12AY7	10/-	30P16	7/-	891R	1200/-	6463	7/-	E80CC	20/-
4X150A		6CG7	10/-	6SG7	6/-	12B4A	9/-	30P18	6/6	954	5/-	6807	150/-	E80CF	27/6
	100/-	6CH6	6/-	6SH7	4/-	12BA6	6/-	30P19	14/-	955	3/-	6939	45/-	E80L	20/-
5R4GY	9/-	6CL6	9/-	6SJ7	7/-	12BE6	5/6	30PL1	16/-	956	2/-	7586	22/6	E83F	22/-
5T4	8/-	6CS6	7/6	6SK7	6/-	12BH7	6/-	30PL13	16 -	958	4/-	7895	22/6	E88CC	12/6
5U4G	5/-	6CW4	12/-	6SL7GT	6/-	12BL6	10/-	30PL14	16/-	959	8/-	8005	110/-	E90CC	10/-
5U4GB	6/6	6CY5	8/-	6SN7GT	5/6	12BY7A		31A3	6/6	1267	20/-	8013	25/-	E91H	8/-
5V4G	8/6	6CY7	11/-	6SQ7	7/-			35A3	10/-	2050	12/6	8020	20/-	E92CC	7/-
5Y3GT	5/-	6D3	7/6	6SR7	7/-	12E1	20/-	35A5	10/-	4052A	30/-	9002	5/6	E150F	17/6
5Z4G	7/-	6D6	3/-	6SS7	3/-	12F5GT	7/-	35B5	12/-	4687	25/-	9003	9/-	E280F	20/-
6/30L2	12/6	6DC6	12/6	6T8	6/6	12J5GT	3/-	35C5	6/-	5544	120/-	9005	15/-	E810F	52/6
6A8G	5/6	6DK6	8/-	6T8A	8/8	12J7GT	7/6	35D5	12/-	5545	150/-	68506	35/-	EABC80	6/6
6AB4	6/6	6DS4	15/-	6U5G	8/-	12K5	8/-	35L6GT	6/-	5551A	300/-	A30D	7/-	EAF42	8/6
6AC5GT		6EA8	11/-	6U7G	7/-	12K7GT	7/-	35W4	4/6	5552A	420/-	A1834	15/-	EB41	5/-
	10/-	6EH7	6/6	6U8	7/6	12K8	8/-	35Z3	10/-	5557	80/-	A2134	8/-	EB91	3/-
6AC7	4/-	6EJ7	6/6	6V4	5/-	12Q7GT	5/8	35Z4G	4/-	5559	80/-	AC HL/DD		EBC33	7/-
6AF4A	3/-	6F4	30/-	6V6G	5/-	12SC7	4/-	35Z4GT	8/6	5641	12/6		8/-	EBC41	8/6
6AG5	2/6	6F5G	8/-	6V6GT	7/6	12SF5	9/-	35Z5GT	5/6	5642	11/-	AC/TH1	8/-	EBC81	6/3
6AH6	10/-	6F6G	5/-	6X4	4/-	12SG7	5/-	42	6/-	5651	7/6	AC/VP2	15/-	EBC90	4/6
6AK5	5/-	6F6GB	6/6	6X5G	4/6	12SH7	4/-	45IU	7/-	5654	8/-	AC5/PEN		EBF80	7/6
6AL5	3/-	6F8G	5/-	6Y6G	10/-	12SJ7	4/-	50A5	12/-	5670	10/-		10/-	EBF83	8/-
6AM6	4/-	6F11	6/-	7A5	8/-	12SK7	5/-	50B5	6/3	5672	7/-				

EBF89	7/-	EL822	16/-	KTZ63	9/-	PL38	16/-	U17	5/-	XC12	6/6				
EBL1	14/-	ELL80	13/-	KTZ73	12/-	PL81	6/6	U18/20	8/6	XC13	14/-				
EBL31	20/-	EM34	13/-	L63	6/-	PL82	7/-	U19	40/-	XC23	14/-				
EC53	10/-	EM71	12/6	ME1401		PL83	6/6	U22	6/-	XB1-3200					
EC86	12/-	EM80	7/-		20/-	PL84	6/6	U25	12/6		120/-				
EC88	11/-	EM81	7/-	ML4	8/-	PL302	13/-	U26	12/6	Y63	8/-				
EC92	6/6	EM84	7/-	ML6	6/-	PL500	13/6	U31	6/6	YL1030					
ECC33	10/-	EM85	11/-	MSPEN	8/-	PL504	15/-	U33	26/-		110/-				
ECC34	10/-	EM87	8/-	MSPENT		PLL80	10/-	U76	4/-	Z303C	35/-				
ECC35	17/-	EMM803			10/-	PM84	8/-	U81	10/-	Z309	8/-				
ECC40	9/6		10/-	MT67	80/-	PT15	15/-	U191	11/-	Z520M	25/-				
ECC81	4/-	EN30	35/-	MU12/14	8/-	PX4	20/-	U281	12/-	Z700U	4/-				
ECC82	5/-	EN31	15/-	N78	16/-	PX25	15/-	U282	12/-	Z759	23/-				
ECC84	6/6	EN91	6/-	NR88	10/-	PY31	5/-	U301	11/-	Z800U	20/-				
ECC85	5/-	EN92	6/-	OCP71	24/-	PY32	8/6	U403	7/-	Z803U	15/-				
ECC86	7/-	EY51	7/-	ORP12	12/-	PY80	5/6	U404	15/-	Z900T	13/-				
ECC88	8/-	EY80	8/-	ORP60	10/-	PY81	6/-	U801	17/-	CV5	95/-				
ECC91	3/6	EY81	7/-	PABC80	7/6	PY82	5/6	U4020	7/6	CV9	10/-				
ECC189	11/-	EY83	9/-	PC86	11/-	PY83	6/-	UABC80	5/-	CV51	5/-				
ECC807		EY84	9/6	PC88	11/-	PY88	8/-	UAF42	9/-	CV66	2/6				
	13/6	EY86	7/6	PC97	7/6	PY301	11/-	UB41	8/-	CV74	80/-				
ECF80	7/-	EY87	8/-	PC900	9/-	PY800	9/-	UBC41	8/-	CV121	20/-				
ECF82	7/6	EY88	8/6	PCC84	5/6	PY801	9/-	UBC81	8/-	CV128	45/-				
ECF83	12/-	EZ11	10/-	PCC85	7/-	QF41	340/-	UBF80	6/6	CV248	7/6				
ECF86	9/6	EZ40	7/6	PCC88	12/-	QP25	5/-	UBF89	7/-	CV284	5/6				
ECH21	9/6	EZ41	8/-	PCC89	11/-	QQV02/6		EBL21	10/-	CV286	5/6				
ECH35	11/-	EZ80	5/-	PCC189	11/-		45/-	UC92	6/-	CV287	8/-				
ECH42	9/6	EZ81	5/-	PCC805	15/-	QQV03-10		ECC84	9/-	CV315	120/-				
ECH81	5/3	GC10B	35/-	PCC806	15/-		30/-	ECC85	6/6	CV397	50/-				
ECH83	7/6	GD90M	12/-	PCF80	6/3	QQV05-P10		UCF80	9/-	CV988	5/-				
ECH84	9/-	GR10A	45/-	PCF82	6/6		60/-	UCH21	9/6	CV2000	9/-				
ECL80	7/-	GS10C	42/-	PCF84	8/-	QQV06/40		UCH42	9/-	CV2101	8/-				
ECL82	6/3	GS10D	50/-	PCF86	8/-		90/-	UCH81	6/3	CV2102	10/-				
ECL83	9/6	GS10H	40/-	PCF87	11/6	QQZ04/15		UCL81	9/-	CV2103	8/-				
ECL84	12/-	GS12D	65/-	PCF800	11/-		60/-	UCL82	7/3	CV2105	7/-				
ECL85	11/6	GS16	7/6	PCF801	9/6	QQZ06-40		UCL83	9/-	CV2107	7/-				
ECL86	9/-	GTE175M		PCF802	9/6		110/-	UF9	10/-	CV2179	8/-				
EF9	7/6		12/-	PCF805		QV03-12		UF41	8/-	CV2218	8/-				
EF22	7/-	GU12	14/-		11/-		10/-	UF42	9/-	CV2294					
EF36	5/-	GU18	85/-	PCF806	12/-	QV04-7		UF43	8/-		700/-				
EF37A	8/-	GU20/21		PCF808			12/6	UF80	9/-	CV2299	12/-				
EF39	6/-		95/-		12/6	QV05-10		UF85	7/6	CV2361	12/6				
EF40	9/-	GU50	35/-	PCL80	14/-		22/6	UF86	9/-	CV2432	10/-				
EF41	8/6	GZ30	7/6	PCF L81	9/-	QV05-25	9/-	UF89	7/-	CV4001	5/-				
EF42	11/-	GZ32	10/-	PCL82	7/-	QV06-20		UL41	9/-	CV4006	18/-				
EF50	5/-	GZ33	12/6	PCL83	9/6		27/6	UL84	6/6	CV4007	7/-				
EF52	8/-	GZ34	10/-	PCL84	7/6	QY3-125		UM4	10/-	CV4009	10/-				
EF54	6/-	GZ37	12/6	PCL85	9/-		160/-	UM80	5/-	CV4010	8/-				
EF80	5/-	HBC90	5/-	PCL86	8/6	QY4-250A		UU5	8/-	CV4012	12/-				
EF85	6/6	HBC91	5/6	PCL88	15/-		230/-	UU7	10/-	CV4013	10/-				
EF86	6/3	HF93	6/-	PCL800	15/-	QY4-400A		UU8	7/-	CV4014	7/-				
EF89	5/6	HF94	6/-	PCL801	15/-		300/-	UU9	7/-	CV4015	9/-				
EF98	10/6	HK90	5/6	PEN4DD	6/-	R10	17/6	UY1N	9/-	CV4017	11/-				
EF183	6/6	HL23DD		PEN45	7/6	R17	8/-	UY21	9/-	CV4018	10/-				
EF184	6/6		6/-	PEN45DD		R18	9/6	UY41	6/6	CV4020	9/-				
EF804	21/-	HL42DD	8/-		12/-	R19	7/-	UY82	9/6	CV4024	6/-				
EH90	7/6	HL92	6/-	PEN46	6/-	SD6	12/-	UY85	6/-	CV4025	7/-				
EL34	9/6	HL94	7/-	PEN220A		SP41	5/-	VL6631		CV4028	9/6				
EL36	8/6	HL133DD			7/-	SP61	4/-		25/-	CV4031	7/-				
EL41	8/6		10/-	PEN383		SU750	45/-	VP41	5/-	CV4044	7/6				
EL42	7/6	KT2	7/-		10/-	SU2150A		VP210	7/-	CV4047	60/-				
EL81	9/-	KT44	5/-	PEN384	7/-		12/-	VU39	8/-	CV4048	12/6				
EL83	7/-	KT45	15/-	PEN453DD		TH233	7/-	VU111	7/6	CV4062	17/6				
EL84	4/3	KT63	6/-		10/-	TH2321	7/-	VU120	12/-	CV4066	5/6				
EL85	7/6	KT66	19/-	PENDD		TP25	5/-	W21	7/-	CV4104	15/-				
EL86	8/-	KT67	45/-	4020	10/-	TT19	7/0-	W81M	6/-	CV4112	80/-				
EL90	5/6	KT71	6/-	PF818	10/-	TT21	35/-	W729	10/-	CV5226	60/-				
EL95	5/-	KT76	8/-	PFL200		TT22	35/-	X66	7/-	CV6051					
EL360	22/-	KT88	27/6		114/-	U10	8/-	X76M	7/6		160/-				
EL821	6/-	KTW63	4/-	PL36	9/-	U12/14	8/-								

WE REQUIRE URGENTLY: KLYSTRONS 2K25 and 723A/B; VALVES 4C35, 813, 5C22, 845, 810. 30/- EACH PAID SUBJECT TO TEST.

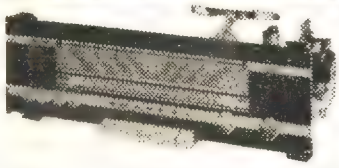
½ PRICE SPECIAL RADIO CHASSIS OFFERS

HI-FI CONTINENTAL STEREOPHONIC RADIOGRAM CHASSIS



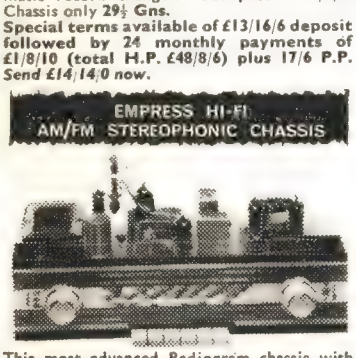
Magnificent "Continental" stereophonic Radiogram chassis with piano key switches, built-in ferrite rod aerial. Comes complete with two 10in. elliptical loudspeakers, plus a mono/stereo 4-speed automatic record changer. **Complete 29½ gns.** (Units available separately if required. **Chassis only 21 gns.**) **Special terms available of £10/6/6 deposit followed by 18 monthly payments of £1/7/3 (total H.P. of £34/17/-) plus 17/6 P.P. Send £11/4/0 now.**

IMPERIAL HI-FI STEREOPHONIC RADIOGRAM CHASSIS



The Imperial stereophonic 4-waveband chassis has the most advanced specifications yet offered in this country. There is a built-in ferrite rod aerial, seven piano key buttons, controlling mono/stereo selection. Gram Long-Medium-Short-FM-ON/OFF. The unit comes complete with two 10in. elliptical loudspeakers plus a mono/stereo 4 speed automatic record changer. **Complete £41/9/6.** Chassis only **29½ Gns.**
Special terms available of £13/16/6 deposit followed by 24 monthly payments of £1/8/10 (total H.P. £48/8/6) plus 17/6 P.P. Send £14/14/0 now.

EMPRESS HI-FI AM/FM STEREOPHONIC CHASSIS



This most advanced Radiogram chassis with automatic push button selection covers Short, Medium and Long wavebands, plus V.H.F./F.M. Offered complete with 2 10 x 6 speakers, 4 speed Stereo/Mono autochanger, only **£35/19/6.** Chassis only **25½ gns.**
Special terms available of £12 deposit followed by 18 monthly payments of £1/11/7 (total H.P. £40/8/6) plus 17/6 P. & P. Send £12/17/6 now.

All Lewis Radio equipment including valves is fully guaranteed for one year, free of charge. Send your cheque or P.O. today while stocks last to Dept. W.97.

LEWIS radio

LEWIS RADIO, 100, CHASE SIDE, SOUTHGATE
LONDON, N.14. Telephone: PAL 3733/9666

WW—143 FOR FURTHER DETAILS

SLYDLOK FUSES 15 amp. 230 v. D.C. 440 v. A.C. **1/6** ea., **15/-** per doz.

HEADPHONES. Balanced armature. DLR5. Brand New. **9/6** pr. Moving coil type, with ear muffs for noise excluding. **12/6** pr. Same fitted with moving coil mike, **17/6** pr. Carbon hand mike, **7/6** each. P. & P. 2/- each item. No. 10 Assembly Headsets and Mic., moving coil, **17/6** ea. P. & P. 2/6.

TANNOY LOUDSPEAKERS. Re-entrant type, ideal for public address, enclosed in waterproof wooden case, complete with steel baffle designed to produce directional reproduction at 5 watts. 7.5Ω. **27/6** each. Carr. 5/-.

SMALL GEARED MOTORS. 12-24 v. D.C., reversible, with gears attached **15/-** ea.; with blower attachment, **12/6** ea.; with fan assembly, **12/6** ea.

TRANSMITTER. BC 625, part of T/R. SCR522. For spares only. Chassis only. Complete with valves. *except* 832s and Relay. **21/-** ea. Carr. U.K. 4/-.

SIEMENS HIGH SPEED RELAYS. H96B type, 50 + 50 ohms. **6/-** ea.; Type H96D, 500+500 ohms, **6/-** ea.; Type H96E, 1,700+1,700 ohms, **7/6** each. Carr. 1/-.

"TELE L" TYPE FIELD TELEPHONES. These telephones are fitted in strong steel case complete with Hand Gen. for calling each station. Supplied in new condition and tested. **70/-** per pr. Carr. 7/6.

POST OFFICE TYPE RELAYS. 3,000 sers. 2 c/o. 2 m., slugged coil 140 ohms; 2 c/o, slugged coil 500 ohms. All at **6/-** each. Carr. 1/-.
3,000 Type, by Ericsson Telephones, 2 1,000Ω 1 Br. 2 Mc. C/O, plus 3 C/Os **12/6** ea., 2,000Ω 4 C/Overs **10/-** ea.; 500Ω 4 C/Overs, **10/-** ea. P. & P. 1/- ea.

MORSE KEYS. No. 8 assembly complete with leads, terminals and cover, **6/6** each. Carr. 2/-.

PRESSURE GAUGE. 2in. round brass case, 0-160lb. **9/6** each. Carr. 1/6.

VIBRATORS. 6 v. 4 pin; 12 v. 4 pin; 12 v. 7 pin. Syn. All **6/-** each. Carr. 1/-.

ELECTRO MAGNETIC COUNTERS. Register up to 9999, coil res. 300Ω **5/-** each. Carr. 1/-. Ex-equipment.

ELECTRIC PRIMING PUMPS. AMERICAN SURPLUS. 24 v. D.C. Overall size 7×2½×2½in. 7 G.P.H. Brand New. **37/6** each. Carr. 2/-.

P.O. TYPE Desk Telephones. Type 162CB, no bell or ringing dial, black only. Brand new, boxed, **27/6.** Carr. 2/6 each.

P.O. TYPE TELEPHONE HAND GENERATORS. 38 v. A.C. New **7/6.** P. & P. 1/-.

MODULATION TRANSFORMERS. 150 watts, suitable for pair 813s, driving 313s. Size 6in.×5in ×3¼in. Brand new, boxed. Price **27/6.** Carr. 4/6.

MEGGER Insulation Tester 500 v. with Contest range from 0.1 ohm to infinity. Bakelite case with hand gen. **£9** ea. Carr. 5/6. 2 ranges, ex-Hoover stock.

CUT OUT. 12 v. or 24 v. operation. Heavy duty silver contacts (5c 849), **7/6** ea. Carr. 1/6.

LIGHTWEIGHT HEADSET (part of "88" W. Set Equipt.) complete with Boom mic., carbon made to highest Ministry Spec. Moving coil earpieces. Our price **35/-** set. Carr. 3/-. Also Super Lightweight hand set, **17/6** ea. Carr. 2/-.

200 AMP. 24 v. D.C. GENERATORS. Type P3, ex Air Ministry, **£9/10/-** ea. Carr. 10/6.

YURA MINIATURE RUSSIAN TRANSISTOR RADIOS. Med. wave, complete with rechargeable Merc. batteries and 2 spare batteries and charger, leather case, only **65/-.** P. & P. 2/-.

P.C.R. 12 V. VIBRATOR POWER PACKS. Brand new, **22/6** ea. P. & P. 5/-.

CONDENSERS. Paper, Sprague, ·1 Mf. 500 v., **5/-** doz. ·1 Mfd. 1,500 v., **7/-** doz. (incl. P. & P.)
HEAVY DUTY TERMINALS. Ex. equip. Black only, will take spade terminals and wander plug. **1/6** pr. **15/-** doz. pairs. P. & P. 1/6 ea. doz.

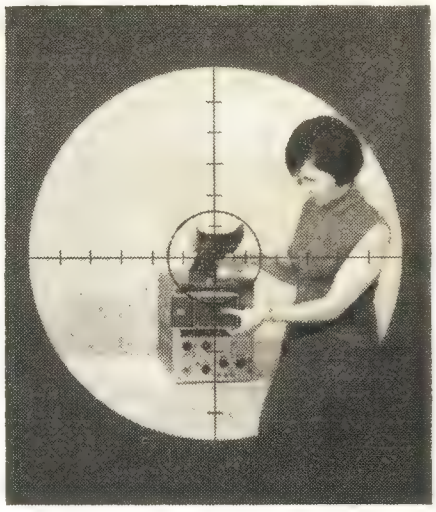
11FT. WHIP AERIALS. 6 Section. Copperised steel and painted. Dia.: ⅛-½in. Complete with moulded base 2½×3½in. **12/6** Complete. P. & P. 2/6.

FATIGUE METERS. 24v. D.C. Consisting of 6× 496D Relays. 500+500Ω. 6×300Ω Electro Mag. counters, etc. **£3/10/-** ea., Carr. 4/6d.

S.A.E. all enquiries.

P. S. Radio and Electrical Stores

108 CHESTER ST., BIRKENHEAD, CHESHIRE



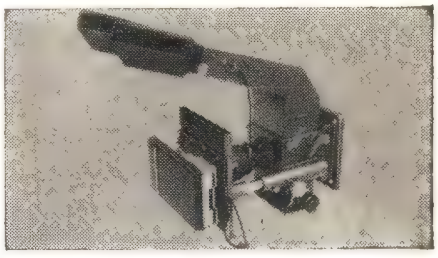
SET YOUR SIGHTS ON A TELFORD CAMERA-

First name in oscillography with camera range including the type "A" with unmatched specification:—

- ✳ Modular construction, over 100 camera combinations available.
- ✳ Polaroid® recording, both roll and pack films.
- ✳ Adaptors, to suit all popular oscilloscopes and many specials.
- ✳ Widest range of lenses, f/3.5 to f/1.3
- ✳ Unique add-to accessories.

Free brochure gladly sent on request. Demonstrations with pleasure.

® Registered Trade Mark of the Polaroid Corp. U.S.A.



TYPE "A" OSCILLOSCOPE CAMERA

TELFORD *PRODUCTS LTD.*
4 WADSWORTH ROAD · GREENFORD
MIDDX · Tel: ALPerton 1011

DAVALL PRODUCT GROUP

A MEMBER OF THE BENTIMA GROUP

WW—144 FOR FURTHER DETAILS

CLASSIFIED ADVERTISEMENTS

DISPLAYED SITUATIONS VACANT AND WANTED: £5 5s per single col. inch.
LINE advertisements (run-on): 6/- per line (approx. 7 words), minimum two lines.
Where an advertisement includes a box number (count as 2 words) there is an additional charge of 1/-.
SERIES DISCOUNT: 15% is allowed on orders for twelve monthly insertions provided a contract is placed in advance.
BOX NUMBERS: Replies should be addressed to the Box number in the advertisement, c/o Wireless World, Dorset House, Stamford Street, London, S.E.1.
No responsibility accepted for errors.

Advertisements accepted up to SEPTEMBER 5 for the OCTOBER issue, subject to space being available.

SITUATIONS VACANT

AN OVERSEAS CAREER with International Aeradio Limited.
TO meet the requirements of constant growth and expansion, we invite applications from technicians and engineers for an overseas career in North, West and East Africa, the Mediterranean area and the Arabian Gulf. If you have recently completed service in a trade such as Ground Wireless Fitter in the R.A.F., Radio Electrical Artificers in the Royal Navy or R.E.M.E., Army, or have other experience in the maintenance of H.F., and V.H.F. communications, R.T.T. and navigational aids, we should be interested to hear from you. Successful candidates would normally spend six weeks at our Radio Engineering School, Southall, Middlesex, before proceeding overseas, but in some cases staff with suitable qualifications and experience may be offered immediate posting. Overseas staff receive a tax-free salary with married and child allowances if appropriate and accommodation, bachelor or married is provided free; other benefits include generous U.K. leave and membership of an excellent pension and life assurance schemes.
WRITTEN applications, please, to Personnel Manager, International Aeradio Limited, Aeradio House, Hayes Rd., Southall, Middlesex. [156

YOUNG Audio-Visual aids technician with a sense of responsibility and a progressive outlook is required; the candidate would be responsible for the maintenance of all types of AVA equipment including tape recorders, 16mm/8mm sound projectors, overhead projectors and sound amplifying equipment, and would work in a department that has its own CCTV studio and an interest in this direction would be an additional qualification; organising ability is essential; salary on scale rising to £935 in first instance.—Applications by letter (no forms) to The Bursar, St. Mary's College, Strawberry Hill, Twickenham. [1819

TELEVISION ENGINEERS (Moslem Faith), operating engineers and microwave engineer required for challenging assignments in Saudi Arabia. Operating Engineers must have two years experience T.V. studios and transmitter operations. Microwave engineers should have City and Guilds final certificate in telecommunications or equivalent and a background in televising including knowledge solid state equipment and T.V. transmitter operation. Contracts for first tour to December 31st, 1968 with start in Autumn. Housing responsibility of the individual under liberal salary scale.—Send curriculum vitae and salary requirements to Box WW 1841, Wireless World.

NUCLEAR SCIENCE and Technology Department, Royal Naval College, Greenwich, requires Scientific Assistant for setting up, calibrating and repair of electronic instruments used in laboratories and to assist experimentalists in operating equipment and collecting data; may be required to work on development of special purpose circuits using solid state devices; experience in maintenance, calibration and testing of electronic instruments desirable; candidates must be British Nationals and have G.C.E. with 4 "O" level passes or equivalent qualification; salary according to age from £426 (age 16) to £821 (age 25).—Write: Secretary, Royal Naval College, Greenwich, S.E.10. [1821

COMMUNICATIONS ASSOCIATES, Ltd., manufacturers of short range H.F., V.H.F. and U.H.F. communications equipment. Due to expansion we require an additional development engineer for interesting and varied work in our R & D department; it is essential that applicants should have had at least 3 years' experience in design of R.F. circuitry; a minimum standard of H.N.C. or equivalent is required though experience will be rated higher than academic qualifications; we are only interested in applicants who are prepared to work in a team and accept responsibility; kindly contact Mr. Cox for an appointment —Exeter 76559 or write direct to: Communications Associates, Ltd., 26/27, Alphington St., Exeter, Devon. [1838

EAST ANGLIAN REGIONAL HOSPITAL BOARD, Regional Engineer's Department. Assistant Electro-Medical Technician. Successful candidate would prepare drawings and undertake other technical work associated with X-ray and other electro-medical equipment and must have served an apprenticeship in electrical engineering and possess a suitable technical qualification. Experience of electronics would be an added advantage. The post is based at the Board's offices in Cambridge but on occasions involves travel to hospitals within the Region and therefore, possession of transport and a current driving licence needed. The starting salary would depend on age, experience and qualifications in one of the following grades. T.A. I: From 1st July, 1967, £1,509-£1,797; from 1st January, 1968, £1,520-£1,870. T.A II: From 1st July, 1967, £1,235-£1,434; from 1st January, 1968, £1,260-£1,470. T.A. III: From 1st July, 1967, £761-£1,197; from 1st January, 1968, £710-£1,240. Applications giving full particulars of age, qualifications and experience, together with names and addresses of three referees to Secretary, East Anglian R.H.B., Union Lane, Chesterton, Cambridge, by 31st August. [1820

ELECTRONIC DESIGN & DEVELOPMENT ENGINEERS (ALL GRADES) SALARIES UP TO £2,800 P.A.
ELECTRONIC TEST & SERVICE ENGINEERS (ALL GRADES) SALARIES UP TO £1,600 p.a.
TECHNICAL SALES ENGINEERS (EXPERIENCED) SALARIES UP TO £2,500 p.a.
TECHNICAL AUTHORS (ALL GRADES) SALARIES UP TO £1,800 p.a.
ALSO
DRAUGHTSMEN, PRODUCTION ENGINEERS

We have over 500 registered vacancies for above types of engineers in the Home Counties and South England areas. If you have had at least 2 years' experience in British Industry and require a job which offers first class prospects, top salaries and interesting work.

Phone (any time day or night) or write to:—

ELECTRONICS APPOINTMENTS LTD.,
Norman House,
105-109, Strand, W.C.2.
TEMple Bar 5557-8.

The Civil Service

Professional and Technical Appointments

RADIO AND ELECTRONIC ENGINEERS — BOARD OF TRADE (CIVIL AVIATION)

Qualified engineers required as Assistant Signals Officers in the field of Civil Aviation for the provision and installation of advanced electronic equipment—including the latest type of radar, telecommunications, navigational aids, etc.
QUALIFICATIONS: Degree with 1st or 2nd class honours in Electrical Engineering or Physics, or have passed all examinations for M.I.E.E., A.M.I.E.R.E., or A.F.R.Ae.S.
AGE: 23 and normally under 35 on 31st December 1967. Some extensions for service in H.M. Forces or Overseas Civil Service.
SALARY (Inner London): On the scale £1,040-£1,985 (will become £1,110-£2,052 on 1st January 1968), depending on age and qualifications. Good prospects of promotion.
(Reference: S/85/ASO.)

EXECUTIVE ENGINEERS — POST OFFICE

About 25 posts in London and provinces for electrical, electronic and mechanical engineers to develop and design communications systems and postal service equipment.
QUALIFICATIONS: Degree in Mechanical or Electrical Engineering, Physics, or Applied Physics, or, exceptionally, very high professional attainment.
SALARY (Inner London): £877-£1,806.
Promotion prospects.
AGE: At least 21 and normally under 35 on 31st December 1967. Some extensions for service in H.M. Forces or Overseas Civil Service.
(Reference: S/322.)

The above posts are pensionable, and APPLICATION FORMS are obtainable from the Secretary, Civil Service Commission, Savile Row, London, W.1. Please quote appropriate reference.

CENTRAL ELECTRICITY GENERATING BOARD

ASSISTANT COMMISSIONING ENGINEER (Instruments)

required at

WYLFA NUCLEAR POWER STATION

Cemaes Bay, Anglesey.

Salary range £1,570/£1,970 p.a. Superannuable.

To assist in commissioning the Instrumentation of Wylfa Power Station. He should have gained an H.N.C. or equivalent qualification and have good background knowledge of electronics. It is essential that the man appointed has practical experience o one or more of the following types of equipment associated with nuclear power stations: (1) Automatic Control Systems, (2) Digital Computers, (3) Closed Circuit television, (4) Nucleonics. Opportunities will occur for transfer to the permanent station staff.

Apply, giving full details to **Regional Personnel Manager, Central Electricity Generating Board, 825, Wilmslow Road, Manchester, 20.** Please quote Vacancy No. E.474/332/W.

TV Service Engineer & Trainee for London retail business of the highest standing; estd. over 40 years; good position and prospects for suitable applicants with high standards of service. State age and details of experience.—Box W.W. 51, Wireless World.

TEST Engineers, to work on the testing of Advanced Solid state D.C. Amplifiers Digital Voltmeter, Spectrum Analysers and instrumentation tape recorders; selection will be on the basis of experience and ability although a minimum qualification of O.N.C. would be desirable, but not essential. Please apply giving brief details of relevant experience to—The Technical Director. Fenlow Electronics, Ltd., Springfield Lane, Weybridge, Surrey. Tel. Weybridge 43978. [1834

TECHNICAL Authors, £2,000 p.a. for Reading and the Home Counties. Applications are invited from Technical Authors and Engineers with radar, communication and data processing experience for permanent and pensionable positions in an expanding company. With productivity bonuses and additional work emoluments could exceed £2,000 p.a. Also required a first-class Circuit Draughtsman to command a good salary. Apply:—Box W.W. 1835, Wireless World.

SNR. TELECOMMUNICATIONS TECHNICIAN required by Pan American at London Airport for modern ground VHF and UHF systems and equipment. Suiable applicants will be considered for supervision of radio workshop. Previous related experience plus at least ONC or equivalent required. Commencing salary approx. £130 p.m. Pension scheme, travel privileges, etc.—Write to Personnel Supervisor, Pan American, London Airport, Hounslow, Middx. [1840

MOUNT VERNON HOSPITAL, Northwood, Middlesex. Electronics Techinician. Physics Department. Duties include maintenance of Linear Accelerator and construction and servicing of electronic apparatus. Applicants should have experience in one or more of these fields. Appointment will be to the Technician III in the range £911 p.a. rising to £1,201 p.a. (plus London Weighting). Salary increase from January 1st, 1968. Applications with full particulars giving age, qualifications and experience to Hospital Secretary. [1824

ST. GEORGE'S HOSPITAL, Hyde Park Corner, London, S.W.1. A senior medical electronics technician Grade III and a student are required in the Physics Department of St. George's Hospital, either at Hyde Park Corner, S.W.1, or Tooting, S.W.17.; the person appointed will be engaged in work dealing with isotopes, scanning, pacemakers and other bio-medical engineering applications.—Further details may be obtained from Mr. J. Davies, M.B.E. Tel. 01-235 4343. Applications with names of two referees to Hospital Secretary, St. George's Hospital, Hyde Park Corner, London, S.W.1. [1818

ASSISTANT ENGINEERS

Expansion—to the extent of 70% increased business in 2 years—has created a number of openings at STC.

ASSISTANT ENGINEER

(STANDARDS): **£1,220**

To work in a team establishing standards of acceptability from basic design information. The work involves appreciation of printed-circuit layout and the function of reed relays as well as other components such as integrated circuits used in electronic switching systems.

ASSISTANT ENGINEERS

(PRINTED-CIRCUIT LAYOUT): **£1,220**

Two assistants are required for design groups producing printed-wiring layouts used in electronic telephone systems.
Direct experience in electronic telephone systems is not essential for the positions advertised. Our expansion has prepared us for advanced training of applicants with experience from other fields of electronics engineering. Please write to or phone:—

Bob Nimmo,
Electronic Switching Division, STC,
Chase Side, London, N.14.
Tel: PALmers Green 6577. Ext. 200

STC

Could you overhaul/repair Airborne Equipment (Radio) products?

This is a job for a practical man with RAF/Fleet Air Arm radio experience who will be based at London Airport.

You will have to prove apprenticeship to a radio firm or service in H.M. Forces, with at least three years' practical experience in radio or an associated field, because the duties involve repair, overhaul, modification and testing of circuits/transmitters/receivers, etc. O.N.C. (Electrical) or C. & G. (Telecommunications) will prove your interest.

Please write or phone:
Bill Bailey, Radio Division, STC,
New Southgate, London, N.11.
Tel: ENTerprise 1234 Ext. 601.

STC

Staff are required in the following grades to participate in expanding production of

RADAR SIMULATORS

SYSTEM DESIGN ENGINEERS —

to carry out design work in order to devise simulation techniques necessary to keep pace with developments in modern radar. Experience in the application of industrial semi-conductor circuits, general familiarity with analogue computing techniques and minimum qualifications of H.N.C. are considered necessary. Recent experience in ground-to-air and marine radar techniques would be an advantage.
Ref: RPG/1.

PROJECT ENGINEERS —

to carry responsibility for the detailed execution of contracts for radar simulators, from planning to final commissioning. Applicants, preferably between 30 and 35 years of age, should have experience in the engineering of complex professional electronic equipment, and must have the ability to organise, and to express themselves clearly in writing. Practical engineering experience and personal drive are more important for these positions than academic qualifications.
Ref: RPG/2.

TEST AND CALIBRATION ENGINEERS —

to carry out fault-finding and calibration work on complete radar simulator sysems, or sub-assemblies. Practical experience with live radar equipment and test room experience with semi-conductor devices would be advantageous. Recent Services experience with radar and navigational equipment is also acceptable. Applicants should be prepared to carry out installation work abroad.
Ref: RPG/3.

PROJECT ASSISTANTS —

to carry out a variety of technical clerical duties necessary for the proper documentation of radar simulator projects. Experience in drawing office procedure, technical parts listing and the production of electronic equipment would be an advantage.
Ref: RPG/4.

SERVICE ENGINEER —

to carry out repairs and modifications to radar simulators at customers' premises both in U.K. and abroad, and in some cases to make the initial installation. A large part of the time would be spent in the factory, assisting during manufacture and calibration. This position would suit a single man, already employed in servicing of radar equipment, and wishing to extend his knowledge into latest computing techniques and the field of radar simulation generally.
Ref: RPG/5.

We offer good conditions of service including contributory pension scheme, free life assurance, etc.

Please apply in writing with full details, quoting reference to: —

Personnel Manager, Redifon Limited,
Gatwick Road, Crawley, Sussex. Tel: Crawley 28811

A member company of the **REDIFFUSION** Group

ENGINEERS plus

IBM computers can give you a future plus

To become a successful IBM Data Processing Customer Engineer, you need more than engineering qualifications. You need to be able to talk confidently and well to any level of customer management, and to have a pleasing personality in your work. As a D P C E, you work in direct contact with your customers, on some of the world's most advanced data processing equipment.

You must have a sound electronic and electromechanical background, such as ONC/HNC Electronic or Electrical, or Radar/Radio/Instrument Fitters course in the armed services.

You will get thorough training on data processing equipment throughout your career. Starting salaries depend on experience and aptitude, but will not be less than £1,100 a year. Salary increases are on merit—within 3 years you could be earning £1,750. Drive and initiative are always well rewarded at IBM; promotions are made on merit and from within the company.

If you would like this chance to become part of a rapidly expanding and exciting computer industry, can maintain a high standard of work in one of the foremost companies in the world, and are between 21 and 31, write to IBM.

Send details of training, experience and age to Miss S. A. Jones, IBM United Kingdom Limited, 389 Chiswick High Road, London, W4, or simply telephone 01-995 1441, quoting reference DP/WW/843.

IBM

Interesting opportunities in telecommunications for Engineers and Draughtsmen

DEVELOPMENT ENGINEERS required for design and development work in the telecommunications field. Cable and Wireless Limited, biggest international communications operator in the world, offers careers of wide scope and interest in the ever expanding field of telecommunications.

Previous experience in solid state techniques is required; a knowledge of data transmission techniques would be advantageous.

Applicants should possess HNC Electrical, its equivalent, or better.

DRAUGHTSMEN required for work in the light mechanical and electronic fields.

Candidates should possess at least ONC Mechanical (or equivalent); previous telecommunications experience would be an advantage.

These career appointments are in London, with excellent conditions of service. Progressive salary scales rising to £2,060 per annum, with accelerated promotion and prospects of further advancement for engineers with professional qualifications.

Please write to Staff Manager, giving brief details of age, qualifications, experience, and present salary.

Cable and Wireless Limited
Dept. 33 Mercury House Theobalds Road London WC1
Biggest international communications operator in the world.

ELECTRONIC ENGINEERS

Service Engineers required for Offices, established throughout the United Kingdom, of well-known Company manufacturing Electronic Desk Calculating Machines. Applicants should possess a sound knowledge of basic electronics with experience in electronics, Radar, Radio and T.V. or similar field. Position is permanent and pensionable. Comprehensive training, on full pay, will be given to successful applicants. Please send full details of experience to the Service Manager, Sumlock Comptometer Ltd., 102/108 Clerkenwell Road, London, E.C.1.

WONDERFUL opportunity for experienced television engineer with some knowledge of tape recorders and photography to take up the position of Sales Engineer for Company entering the Video tape recording field; tremendous scope for right man with experience, enthusiasm, ability and desire to earn up to £2,000 p.a., plus.—Write in confidence to Mr. Allerhand, Associated Videotape, Magnatape House, 191, Plashet Rd., E.13. [49

THE LONDON HOSPITAL, Whitechapel, E.1. Technician III required for electrical/electronics work in new Intermittent Dialysis Unit; the person appointed will be responsible for servicing and maintenance of monitoring equipment, and all other electrical apparatus including micropumps; he will also be expected to be "on call" for emergencies; salary and conditions according to Whitley Council and experience. Write to House Governor. [1836

NUCLEAR ELECTRONICS. A post exists in the Nuclear Electronics Department for a person with a good knowledge of electronics, to work on the development and maintenance of electronic equipment used in research work, reactor control and safety systems. Salary with the range £766-£968 or £1,004-£1,215 per annum, plus supplement for H.N.C.—Applications to Administrative Officer, Universities Research Reactor, Risley, Nr. Warrington. [1817

RADIO TECHNICIANS

A number of suitably qualified candidates are required for permanent and pensionable employment (mostly in Cheltenham, but from time to time there are some vacancies in other parts of the U.K., including London). There are also opportunities for service abroad.

Applicants must be 19 or over and be familiar with the use of Test Gear, and have had practical Radio/Electronic workshop experience. Preference will be given to candidates who can offer "O" level GCE passes in English language, Maths. and/or Physics, or hold the City and Guilds Telecommunications Technician Intermediate Certificate or equivalent technical qualifications.

Pay according to age, e.g. at 19—£812 at 25—£1046 (highest age pay on entry) rising on 1.1.68 to at 19—£828, at 25—£1,076

Prospects of promotion to grades in salary range £1,159-£1,941. There a few posts carrying higher salaries.

Annual Leave allowance of 3 weeks 3 days rising to 4 weeks 2 days. Normal Civil Service sick leave regulations apply.

Application forms available from:—
Recruitment Officer (RT),
Government Communications Headquarters,
Oakley, Priors Road,
Cheltenham, Glos.

SENIOR TEST ENGINEERS

The Transmitter Test Department of Pye T V T Limited require Senior Test Engineers for Work on VHF and UHF Television Transmitter Equipment. Applicants should possess H.N.C. and have had at least three years' experience in the testing of Transmitter Equipment.

Opportunities also exist for Junior Test Engineers with good prospects for promotion. Salary will be negotiable according to experience.

Write in confidence to the:

Personnel Officer,
Pye T V T Limited,
Coldhams Lane,
Cambridge.

TEST ENGINEERS to work on the testing of advanced solid state D.C. amplifiers, digital voltmeters, spectrum analysers and instrumentation tape recorders. Selection will be on the basis of experience and ability although a minimum qualification of O.N.C. would be desirable but not essential. Please apply giving brief details of relevant experience to the Technical Director **Fenlow Electronics Ltd.,** Springfield Lane, Weybridge, Surrey. Tel.: Weybridge 43978.

Radio/ Radar Mechanic

Required by the EAST AFRICAN COMMON SERVICES ORGANISATION, Meteorological Department, for service as a Sectional Engineer, Grade II, on contract for one tour of 24-27 months in the first instance. Commencing salary according to experience in scale rising from £1,940 to £2,200 per annum (including allowances). Gratuity 25% of total salary drawn. Free passages. Accommodation at moderate rental. Liberal leave on full salary. Children's education allowances.

Candidates, under 45 years of age, should possess the O.N.C. in either Telecommunications or Electronics, or the Final Certificate of City and Guilds Group Course in Telecommunications, or equivalent experience in the Armed Services. They should have a good theoretical and practical knowledge of meteorological radio telecommunications equipment and a good working knowledge of Mufax and facsimile transmitters and receivers and radar systems. Duties will include the training of local staff.

Apply to CROWN AGENTS, M. Dept., 4 Millbank, London, S.W.1 for application form and further particulars, stating name, age, brief details of qualifications and experience and quoting reference M3D/61323/WF.

All Systems are GO!

We need top men, leaders and assistants at STC. Our business has increased 70% in volume **during the time of the freeze and squeeze!** And it's growing. So there are good jobs—secure jobs—at STC for men who have the initiative and the basic knowledge to make their marks in top-line positions.

Systems Evaluator—£1,900

You will need to have the quality of leadership, as well as experience in data systems, for example, computers, or certain aircraft check-out applications.
Your Job: the senior position—leader—of a Systems Test Team. You will evaluate systems with the aid of your team, and agree design modification with system designers to achieve an optimum system.

Systems Laboratory Engineer—£1,700

You will have had experience in making digital data systems work and in putting prototype systems through their paces before full-scale manufacture.
Your Job: a key position in a Systems Test team; second only to the Systems Evaluator (outlined above). Where he has administrative and technical problems, it will be your function to evaluate system worthiness and devise test methods.

Equipment Standard Engineer—£1,800

You will have a working knowledge of circuits and equipment practices. Your experience will enable you to evolve equipment layouts for new systems.
Your Job will consist of analysing basic logic and systems design. Your conclusions will enable you to make proposals for suitable mounting practice and the over-all construction of an exchange.

Lab. Assistant Engineer—£1,220

You will have O.N.C. and be working for H.N.C. Your experience may be that of an ex-P.O. Technical Officer, used to test instruments and circuit testing.
Your Job will be in the Systems Laboratory, assisting on the practical side, but with enough technical knowledge to be of real help to the Systems Lab. Engineer described above.
Progress at STC—You may not have actually held one of the positions described above. But if you have the necessary relevant experience to entitle you to a chance of progress, please write to or phone:

Bob Nimmo,
Electronic Switching Division, STC,
Chase Side, London, N.14.
Tel: PALmers Green 6577. Ext. 200

STC

Electronics Research Technicians

are required to assist research staff at the Electricity Council Research Centre in the design, construction and operation of modern electronic circuits and equipment.

Applicants should be experienced craftsmen (minimum age 25) preferably with further training to O.N.C./H.N.C. standard.

Appointments will be made in the grade of Laboratory Technician on a scale rising to £1,385 (+ £60 allowance) at a point commensurate with ability, experience and age.

Please apply to: Mr. D. C. Page, Head of Personnel Services, quoting reference number WW/85

ELECTRICITY COUNCIL RESEARCH CENTRE

Capenhurst, near Chester.

TEST ENGINEER

for

ELECTRO MEDICAL and X RAY EQUIPMENT

Minimum qualification 'O.N.C.', fault finding experience essential. Experience of design and maintenance of test gear an advantage, applications from engineers with suitable experience should be addressed to:

Personnel Officer,
Philips, Balham,
45, Nightingale Lane,
London, S.W.12.

UNIVERSITY OF KEELE

DEPARTMENT OF COMMUNICATION

Research Assistants required for programme of basic research into perceptual and communication problems of the blind and deaf. Salary, according to qualifications, in scale £1,050-£1,740 with F.S.S.U. Multidisciplinary approach projected, combining techniques of experimental psychology, electro-physiology and electronics. Digital computer available for on-line control and analysis of experiments. Candidates with experience in electronics, experimental psychology, electro-physiology, or computer techniques are invited to apply to the Registrar (WW), The University, Keele, Staffs, from whom application forms can be obtained for return by 25th September, 1967.

TRAINED engineers required for interesting work on radio/radar equipments at a flying unit in North Wales. Apply:—Short Bros. & Harland, Ltd., R.A.E. Llanbedr, Merioneth, N. Wales. [170

A FULL-TIME technical experienced Salesman required for retail sales; write giving details of age, previous experience, salary required to—The Manager, Henry's Radio, Ltd., 303, Edgware Rd., London, W.2. [1830

BRITISH ANTARCTIC SURVEY requires Wireless Operators to serve in the Antarctic. Candidates must be able to transmit and receive 20 w.p.m. Salary according to qualifications. Applications to:—30, Gillingham St., London, S.W.1. [1828

AIRCRAFT Radio Engineers and Mechanics with specific workshop experience in one of the following: VHF/HF, ILS/VOR, or ADF. Pension scheme, 3 weeks holiday per year.—Apply, Managing Director, Air Transport (Charter) (C.I.), Ltd., Willow Rd., Colnbrook, Bucks. Tel. Colnbrook 2654. [1783

TEST Engineer with knowledge of radio-communication design and manufacture, required by small but fast expanding company in S.W. London. Applicants should have knowledge of H.F. transmitters and/or receivers and be generally familiar with the test equipment and procedure used in this field. Box W.W. 1825, Wireless World.

EXPERIENCED Hi-Fi/Tape Recorder Salesman; excellent salary for capable person.—Telesonic, Ltd., 01-636 8177. [1816

EXPERIENCED Cinema Sound Engineer required for service and installation; good salary and conditions.—Box W.W. 1822, Wireless World.

STOREKEEPER with some experience in electronic components, preferably valves, and with steady employment record required for permanent position with Z & I Aero Services, Ltd. Salary approx. £17 p.w., 5-day, 40-hour week, occasional overtime. Apply:—44A Westbourne Grove, London, W.2. Tel. Park 5641 [1831

TEST Engineers required; experienced in testing radio communications equipment; must be able to diagnose fault conditions, and align and calibrate such equipment; staff appointments, excellent starting salaries.—Call, 'phone or write: The Personnel Manager, Redifon Ltd., Broomhill Rd., Wandsworth, London, S.W.18. Vandyke 7281. [1815

ELECTRONIC WIREMEN & TESTERS for production of Console Public Address Rack equipment; previous experience an advantage but not essential; salary by negotiation; we are a rapidly expanding company; suppliers to many National British Companies; we require men of good calibre to grow with us.—Apply E.G.D., Ltd. Fulham 7977. [1814

WEST London Aero Club invite "A" and "B" licensed engineers with capital and/or necessary equipment to commence Radio Workshop. Alternative propositions may be considered. Write full details to—White, Waltham Airfield, near Maidenhead, Berks. [158

BOOKS, INSTRUCTIONS, ETC.

MANUALS, circuits of all British ex-W.D. 1939-45 wireless equipment and instruments from original R.E.M.E. instructions; s.a.e. for list, over 70 types.—W. H. Bailey, 167a, Moffat Road, Thornton Heath, Surrey. CR4-8PZ. [143

TAPE RECORDING ETC.

TAPE to disc transfer, using latest feedback disc cutters; EPs from 21/-; s.a.e. leaflet.—Deroy, High Bank, Hawk St., Carnforth, Lancs. [162

MISCELLANEOUS

METALWORK, all types cabinets, chassis, racks, etc., to your own specification, capacity available for small milling and capstan work up to 1in bar. PHILPOTT'S METALWORKS, Ltd., Chapman St., Loughborough. [151

UNIVERSITY COLLEGE LONDON
DEPARTMENT OF PHARMACOLOGY

Senior Electronics Technician required for design and development of equipment used in biological and medical research. Work offers great scope for individual initiative with minimum of maintenance duties. H.N.C. or equivalent desirable.

Application forms from:—

Establishment Officer, University College London, Gower St., W.C.1. quoting Pharm/1.

NATIONAL AIR TRAFFIC CONTROL SERVICES

Radio Technicians

****

The Board of Trade has vacancies for men wanting vital and interesting work on the latest equipment in TELECOMMUNICATIONS FOR CIVIL AVIATION at Civil Airports, Air Traffic Control Centres, Radar Stations, and other Engineering Establishments.

Qualifications. Practical experience in at least one of the main branches of Telecommunications. Preference will be given to those candidates with City and Guild Certificates or O.N.C. in Engineering.

Age. 19 or over.

Salary. From £812 (at 19) to £1,046 (at 25 or over); scale maximum £1,201. From 1st January 1968 these rates will become £828 (at 19) to £1,076 (at 25 or over); scale maximum £1,242. Non-contributory pension for established staff.

Career Prospects. Radio Technicians are encouraged to study for higher technical and professional qualifications. They are helped in this by part time and, in special cases, full time release. Once qualified, there are excellent prospects of established posts and promotion to higher grades with a salary maximum of £2,174 (£3,105 from 1st January 1968).

Write for details to: Mr.T. H. Mallett, B.Sc.(Eng.) C.Eng., M.I.E.E., Room 754, The Adelphi, London, WC2, marking your envelope "Recruitment EJ 6702/1".

Name _____

Address _____

_____

_____

Not applicable to residents outside the U.K.

PETO SCOTT PETO SCOTT PETO SCOTT PETO SCOTT PETO SCOTT

ARE YOU ONE OF THE FEW MEN WITH THE COLOUR TELEVISION EXPERIENCE WE ARE LOOKING FOR?

● SENIOR DESIGN ENGINEERS

Senior engineers who have successfully led, or been part of, a team designing colour T.V. equipment are offered an opportunity to work on a new generation of colour T.V. equipment for a world wide market. They will take part in the interchange of ideas with overseas design centres of the Concern. Full backing by supporting services is available.

● DESIGN ENGINEERS

There are also vacancies for Designers familiar with monochrome T.V. circuitry to work on a range of T.V. monitors and peripheral T.V. equipment.

● TEST ENGINEERS

We invite applications from engineers able to diagnose and clear faults on transistorized equipment based on pulse circuitry. Salaries, conditions of employment and working environments are attractive.

Please write with brief details, qualifications and experience quoting vacancy to:

THE PERSONNEL OFFICER

PETO SCOTT
sound and vision

Weybridge Trading Estate, WEYBRIDGE, SURREY

PETO SCOTT PETO SCOTT PETO SCOTT PETO SCOTT PETO SCOTT

ITA

TECHNICAL ASSISTANTS WITH

THE INDEPENDENT TELEVISION AUTHORITY

In addition to its present service, Independent Television will soon be entering the field of colour TV and UHF Engineering; the future is therefore one of interest and development. The Authority requires young men with some experience in electronics to join its engineering staff; they will be based at Transmitting Stations throughout the United Kingdom and be engaged in the operation and maintenance of television transmitting and ancillary equipment.

SALARY—Commencing salary is in the range **£950-£1,225** per annum; subject to qualifications and satisfactory work, salary will progress to **£1,650.** There are **PROMOTION PROSPECTS** to posts above this level; the Authority's policy is to promote its existing staff whenever possible.

HOURS—Duties are on a shift basis (day and evening) averaging 8 hours with a weekly average of 42 hours inclusive of meal breaks. The evening shifts finish shortly after programme close down at about midnight.

QUALIFICATIONS—Normally a Higher National Certificate or its equivalent would be required but as excellent residential training courses are provided, young men who have not reached this standard will be considered, provided their background and experience is suitable.

If you would like to enter this interesting and developing field of engineering, please apply to:—

PERSONNEL OFFICER
THE INDEPENDENT TELEVISION AUTHORITY
70, Brompton Road, London, S.W.3 Quoting Reference WW/583

NORTHERN POLYTECHNIC
Holloway, N.7. 01-607 6767

Department of Physics

PART-TIME COURSES IN APPLIED PHYSICS 1967-68

HIGHER NATIONAL CERTIFICATE
A1 Wed. 6-9
Fri. 9.45 a.m.-1 p.m., 2-5, 6-8.30
A2 Wed. 9.30 a.m.-1 p.m., 2-5, 6-9

ENDORSEMENT COURSES for L. Inst. P.
Nuclear radiation and counting techniques.
Further electronics.
Transducers and optical detectors.
Mon. 10 a.m.-1 p.m., 2-5, 6-9.

GRAD. INST. P. Part II. 2-year part-time course.
Mon. 10 a.m.-1 p.m., 2-5, 6-9.
Thurs. 6-9.

All courses start in week beginning 2nd October, 1967.
Enquiries to Head of Department of Physics.

Maintenance Engineer 26/35 yrs. with knowledge of electronics and mechanical aptitude required for field servicing. Initially work will be in London area. However, applicants must be prepared to travel and may be posted to associated company in U.S.A.

Write to L.V.P. Electronic Development Co., 9 Aintree Road, Perivale or phone 997 9943.

TWO E.M.I. TR51 tape recorders, full track 7½ and 15 I.P.S., £55 each. Offers considered. Tel. Tem. 7877. [1842

SAPPHIRE Cutters direct from the manufacturers, to fit all types of disc recording heads. By return re-lapping service.—Martin Watch Laboratories, London Rd., Binfield, Bracknell, Berks. Tel. Bracknell 4935. [4

AERIALS. All bands, radio, stereo, T.V., colour, etc., advisory service; full catalogue, 1/- stamps.—Audio Workshops, Ltd., Burnt Lodge Lane, Wallcrouch, Wadhurst, Sussex. Ticehurst 503 or Hastings 3591. [53

PEGASUS Computer Components, all packages, converters, Hollerith card punch and reader, Electrodata tape units, H.S. tape readers, stabilised power units, motor generators and control gear; offers for all or part, to:—Auto Electronic Developments, 2, Brewery Lane, Thornhill Lees, Dewsbury. [1833

SALE.—Setar 8-channel timing and recording system: records to nearest 1/100 sec. on 5-hole teleprinter tape; for use in ergonomics, experimental psychology, etc.; a computer programme for analysis available; cost £1,435 in 1964, little used and well cared for; £700 or near offer.—Apply to K. Kapota, Institute of Experimental Psychology, 1, South Parks Rd., Oxford. [1837

DRIVE in safety, see and be seen. dimmed beam lighting units, contents, 12-volt relay, FZS 70 diode, 1 ohm 30Watt res., cable connectors and fixing bracket, price 12/6, post 1/-, fitting instructions supplied. Emergency flasher unit, switch on in the event of a breakdown to warn other road users, complete kit comprising 12-volt relay, resistors, connectors, switch, indicator light and dash fitting escutcheon, price 17/6, post 1/-. B.B.C. or v.h.f. indoor dipoles, complete with 6ft of cable, 75 ohm, 5/-, post 1/-. Wire ended neons, strike 80 volt, 1/- post paid. 5-inch rounded speakers, 3/6, 6×4, 3/6; 8in, 6/-, post 4/6. Fireball tuners, in good conditions, 17/6, post 2/6. Hexegon and 8mm trimming tools, 3/6 per set, post paid.—R. &R. Radio, 51, Burnley Rd., Rawtenstall, Rossendale, Lancs. [1832

SERVICE & REPAIRS

B.B.C.2. TV, RADIO, TAPE REC. SERVICE SPARES, U.H.F./625, modify your set to B.B.C.2, 1955 to 1963 models covered, manufacturers' complete kits and tuners; send for free list. Ferguson 625 IF amp chassis 39/6 (or less valves 19/6), circuit and instr. 3/6, p/p 4/6. Philips complete 625 conversion kit including circuit 70/-, p/p 6/-. GEC/Sobell sound and vision dual 405/625 IF amp and output chassis 42/6, p/p 4/6. New UHF tuners including valves 29/6, or Philips transistorised 70/-, p/p 4/6. Fireball Tuners, new, tested, exclusive offer of special manufacturers types suitable for KB, Ultra, Ferguson, HMV, etc., 75/-, new turret tuners, Brayhead 3001/3 58/6; Cyldon c/f 19/6; Brayhead 10, 16, 35Mc/s 19/6; KB 16, 38Mc/s 10/-; Ekco 16Mc/s 10/-, post 4/6, many others available. TV Signal Boosters, transistorised, Pye/Labgear B1/B3 and u.h.f. battery 75/-, u.h.f. mains 97/6, u.h.f. masthead 105/-, post free; L.O.P.T.s, scan coils, framed output transf. mains droppers, etc., for all popular makes CRTS. 14, 17, 19in from £4/3 (callers only). Tape recorder belts, heads, motors, etc. Salvaged components, large selection transformers, scan coils, turrets, etc. Enquiries invited, c.o.d. despatch available. Manor Supplies, 64, Golders Manor Dr., London, N.W.11; callers 589B, High Rd., N. Finchley, N.12 (near Granville Rd.). Hil. 9118 (day), Spe. 4032 (evg). [16

REPAIRS.—Our modern service department equipped with the latest test equipment including a wow and flutter meter and multiplex stereo signal generator is able to repair Hi Fi and tape recording equipment to manufacturers' standard.—Telesonic, Ltd., 92, Tottenham Court Rd., London, W.1. 01-636 8177. [169

ARTICLES FOR SALE

WAVE analyser type 705B by Dawe Instruments; £25, carriage extra.—J. Cooper, Churchfield Road, Outwell, Wisbech, Cambs. [52

MULLARD electronic valve tester, comp. trolley stand and cards; £35. Also Quad Acoustical Speaker, unused, £25.—2, St. John's St., York 53488. [1827

LAFAYETTE HE30 receiver, 0.55-30 mc/s, electrical bandspread, Q-multiplier, AVC-MVC selector, BFO, S-meter, HE48 speaker, £20 o.n.o.—Box W.W. 50, Wireless World.

RECEIVER Type R107 1.2 to 17.5 mc/s 100-250V 50 cps or 12V d.c. supply, good condition; £10.—B. Himsworth, 3, Mayfield Rd., Tunbridge Wells, Kent. Tel Tunbridge Wells 23735 [56

TEST equipment, Advance 71 v.h.f. signal generator, tested with charts, £14; CT 53 v.h.f. signal generator, tested, £14; Geiger counter, £5; s.a.e. for full list.—G3PUR, 81, Rctory Gardens, Worthing. [55

PHILIPS ELECTRICAL LTD.
(Medical Apparatus Division)
45, Nightingale Lane, Balham, S.W.12

HEARING AID DEPT.

Technician required for the service and repair of Hearing Aids. Previous experience in this field desirable. Hours 8.45 to 5 p.m. 5 day week. Pension Scheme. Apply to Personnel Officer at the above address or telephone KELvin 7766 for an appointment.

assistant telecommunications engineers

Required by the EAST AFRICAN POSTS AND TELECOMMUNICATIONS ADMINISTRATION on contract for one tour of 24 months in the first instance. Commencing annual salary £1,994 in scale rising to £2,262 (including allowances). Gratuity 25% of total basic salary and overseas addition. Generous overseas installation grant. Free passages. Liberal leave on full salary. Accommodation provided at low rental. Education allowances.

Candidates between 28 and 45 years of age, must have a wide telecommunications engineering background and possess sound experience and a thorough knowledge of one or more of the following:— (i) Automatic telephony; (ii) Carrier and transmission; (iii) Power plant; (iv) Telegraph equipment; (v) Overhead trunk routes; (vi) Engineering construction (Internal); (vii) General area maintenance including Subscribers apparatus, underground cables and overhead lines; (viii) V.H.F. Radio. A City and Guilds Intermediate Certificate and pass in one of the following is also required:— (a) Telephone Exchange Systems grade 2; (b) Radio Grade 2; (c) Telegraphy Grade 2; (d) Line Transmission Grade 2. Selected officers will be required to train African staff and some duties may involve spending long periods on safari in training areas.

Apply to CROWN AGENTS, M. Dept., 4, Millbank, London, S.W.1, for application form and further particulars, stating name, age, brief details of qualifications and experience, and quoting reference M3D/62721/63005/WF.

The 4 GeV Electron Synchrotron (NINA) is now operational and is being used for research into high energy physics by university and resident groups.

TECHNICIANS

are required to work in the Machine Group as members of operating teams. They will also have responsibilities for maintaining the Synchrotron and improving its performance and reliability. They will be expected to contribute to the future success of this exciting new field of accelerator physics.

It is expected that by the end of 1967 some three shift working will be involved.

Appointments will be made in the following salary scales according to age and experience.

Grade I £1,402-£1,727
Grade II £1,228-£1,402
Grade III £866-£1,228

For the Grade III posts starting salaries will be according to age, e.g., **£866** at 21, **£931** at 23, **£1,028** at 26, **£1,098** at 28 and over. These are interim scales and revised scales will be payable from 1st of January 1968.

Applicants should have served a recognised apprenticeship or have had comparable training. They should possess an O.N.C. (for the Grade II or III posts), and an H.N.C. (for the Grade I posts) in Electrical Engineering or Applied Physics. Good experience in the fields of electronics, instrument technology or light electrical engineering is required. Experience in the field of accelerator engineering would be an advantage.

There is a non-contributory superannuation scheme and professional advice and assistance to obtain 100% house loans is available.

Science Research Council

DARESBURY NUCLEAR PHYSICS LABORATORY

Write for application form quoting reference DL/172/M to:—

Personnel Officer,
SCIENCE RESEARCH COUNCIL,
Daresbury Nuclear Physics Laboratory, Daresbury, Nr. Warrington, Lancs.

Closing date for the receipt of completed application forms 31st August, 1967.

LONDON ELECTRICITY BOARD

ASSISTANT ENGINEERS (Communications) (2)

Applications are invited for the above-mentioned positions in the Chief Engineer's System Operations Branch. The successful applicants will be based at Alpha Place, Chelsea, S.W.3, but will be required to undertake duties anywhere within the Board's area.

Applicants should have had a sound technical education and have some practical experience in at least one of the following:—

Automatic telephone exchange systems.

Electro-mechanical supervisory systems.

Electronic logic and data transmission.

V.H.F. and U.H.F. Mobile Radio.

Salary Scale £1,310/£1,545 p.a. incl.

Application form obtainable from the Personnel Officer, 46 New Broad Street, E.C.2 to be returned completed within 14 days of the publication date of this notice. Please quote ref: PER/V/6548/FU.

NORTHERN POLYTECHNIC
Holloway, N.7. 01-607 6767

Department of Physics
POSTGRADUATE COURSES 1967-68

COURSES LEADING TO M.Sc. (University of London) or to a Postgraduate Diploma.
(The lecture courses are not restricted to students taking these qualifications.)

THE PHYSICAL BASIS OF ELECTRONICS
Full-time course:
Part-time day course: Mon. 10-1, 2-5, 6-9
Fri. 6-9
Evening course: Tues. 6-9 Fri. 6-9

ELECTRICAL DISCHARGES IN GASES
Evening course: Tues. 6-9 Fri. 6-9

SHORT LECTURE COURSES

THE PHYSICS OF MAGNETIC RECORDING
(9 lectures) Tues. 6.30-9

MODERN PARTICLE COUNTING CIRCUITS
(10 lectures) Fri. 6.30-8

Enquiries to the Head of Department of Physics.

A BETTER deal for cash customers. We do not provide interest-free credit but offer a generous discount of 15% for cash; call, write or phone; every item of equipment despatched brand new in sealed cartons on receipt of remittance with order; agents for all leading makes; amplifiers, tuners, motors, pick-ups, loudspeakers and tape recorders.Audio Services, Ltd., 82, East Barnet Rd., New Barnet, Herts. Tel. Barnet 6605. [161

Fare Paid to USA for Electronic Technician, or junior Engineer—interesting position—diode lasers.

Seed Electronics Corporation
258 East St., Lexington, Mass. 02173, USA.

CIRCUIT diagram or service sheet wanted for Hacker "Sovereign" RP18 portable receiver.—Box W.W. 48, Wireless World.

FI-CORD recorder battery charger required quickly, please.—Iliffe, Brookfield, Wigton, Cumberland. [1809

HIGH quality valve voltmeter, and sine and square valve signal generator; reasonable price.—Clement Wain, Ltd., Newcastle, Staffordshire. [1829

WANTED, Advance DI/D sig.-generator, reasonable, sell BPL capacitance bridge electrolytic, ZD 00506; £30, cratd, as new.—Coates, Bridge St., Whitby, Yorks. [54

HIGHEST prices paid for certain G.E.C. and other relays in any condition, also wanted, notched relay contacts, s.a.e. details.—Eley Electronics, 112, Groby Rd., Glenfield, Leicester. [1810

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [140

ARTICLES WANTED

WANTED.—Cash paid for valves, televisions, radios, any quantity.—S. Willetts, 43, Spon Lane, West Bromwich, Staffs. [162

NEW GRAM AND SOUND EQUIPMENT

GLASGOW.—Recorders bought, sold, exchanged; cameras, etc., exchanged for recorders or vice-versa.—Victor Morris, 343, Argyle St., Glasgow, C.2. [120

Government of MALAWI

REQUIRES

TELECOMMUNICATIONS ENGINEERS

On contract for one tour of 24-36 months in the first instance. Commencing salary according to experience in scale (including overseas addition) £1135 rising to £1905 a year. A supplement of £100 a year is also payable. Gratuity (free of Malawi tax) 25% of total salary drawn for tour of 30 months or over or 15% for a tour of 24 but less than 30 months. Outfit allowance £30. Free passages. Liberal leave on full salary. Generous education allowances. Quarters at low rental. Contributory pension scheme available in certain circumstances.

Candidates, preferably aged 25-45 years, must have at least 5 years experience in either of the following branches of telecommunications engineering, after completion of two years' approved training; Carrier and V.H.F. Equipment; HF Radio and A.R.Q. Equipment. They must possess at least one appropriate City and Guilds Certificate. Previous overseas experience and experience in training and supervision of subordinate staff would be advantageous.

Apply to CROWN AGENTS, M. Dept., 4, Millbank, London, S.W.1., for application form and further particulars, stating name, age, brief details of qualifications and experience, and quoting reference M3D/62648/WF.

The 4 GeV Electron Synchrotron (NINA) is now operational and is being used for research into high energy physics by university and resident groups.

EXPERIMENTALISTS AND TECHNICIANS

who have experience of radio frequency techniques at U.H.F. and S. Band or of high voltage pulse forming systems or alternatively a strong interest and experience in electronics or accelerator physics are required for the Machine Group.

For part of the time they will provide specialist advice as members of the operating crew of the synchrotron. It is expected that some three shift working will be involved in this aspect of the work by the end of 1967.

For the remainder of the time the technicians will assist the experimentalists in carrying out research and development aimed at maintaining the linear accelerator and synchrotron in a high state of efficiency and as a leader in the field of nuclear physics.

Appointments will be made on the following scales according to age, qualifications and experience.

Senior Experimental Officer	**£1977-£2411**	**Technician Grade I**	**£1402-£1727**
Experimental Officer	**£1365-£1734**	**Technician Grade II**	**£1228-£1402**
Assistant Experimental Officer	**£568-£1243**	**Technician Grade III**	**£866-£1228**

The Technician salary scales are interim and revised scales will be payable from 1st January 1968.

For the Experimentalist posts (Reference DL/173/M) a pass degree or H.N.C. in electrical engineering or applied physics is required but consideration will also be given to applicants under the age of 22 who have 5 G.C.E. passes including 2 at A level in scientific subjects.

For the Technician posts (Reference DL/174/M) applicants should have served a recognised apprenticeship or have had comparable training and possess an O.N.C. (for the Grade II and III posts) and an H.N.C. (for the Grade I posts) in electrical engineering or applied physics.

There is a non-contributory superannuation scheme and advice and assistance to obtain 100% house loans is available.

Science Research Council

DARESBURY NUCLEAR PHYSICS LABORATORY

Write for application form, quoting appropriate reference number to:

The Personnel Officer, SCIENCE RESEARCH COUNCIL, DARESBURY NUCLEAR PHYSICS LABORATORY, Daresbury, Nr. Warrington, Lancs.

Closing date: August 31st 1967.

Government of ZAMBIA

REQUIRES

RADIO SPECIALISTS

On contract for one tour of 36 months in the first instance. Salary according to experience in scale rising from £1645 to £1855 gross per annum. A supplement of not less than £200 per annum is also payable. Gratuity 25% of total salary drawn. Liberal leave on full salary or terminal payment in lieu. Free passages. Quarters at low rental. Children's education allowances. Outfit and plain clothes allowances.

Contributory Pension Scheme available in certain circumstances.

Candidates must have completed an approved apprenticeship of five years or hold a Service Trade Certificate or equivalent qualification and have had at least six years' post-qualification experience in the installation and maintenance of modern low and medium power H.F. equipment, S.S.B. and I.S.B. equipment, and of V.H.F. equipment, including multiplex links. Knowledge of maintenance of teleprinters, diesel and petrol generators preferred. Duties include travel by road and air and training Zambian officers for City and Guilds.

Apply to CROWN AGENTS, M. Dept., 4, Millbank, London, S.W.1., for application form and further particulars, stating name, age, brief details of qualifications and experience, and quoting M3D/61274/WF

AIR FORCE DEPARTMENT

ARE YOU:

★ **INTERESTED IN DOING VITAL WORK ON RAF RADAR AND WIRELESS EQUIPMENT?**

★ Aged 19 or over and of good educational standard (GCE "O" level passes in English Language, Maths. and Physics. City and Guilds Telecommunications Technicians Certificate or equivalent qualifications are desirable though not essential).

★ Experienced in radio/radar servicing.

IF SO, WE OFFER:

★ A first class opening as a Civilian Radio Technician. Present salary starting at up to £1,046 p.a. (according to age) and rising to £1,201 (up to £1,076 rising to £1,242 p.a. on 1st January 1968), and good prospects of promotion (top posts in excess of £2,000 p.a.).

★ Facilities for Day release on full pay to attend ONC, HNC, City and Guilds etc., courses at Technical College.

★ 5-day week. 3 weeks, 3 days' annual leave at the start rising to 6 weeks, plus public holidays.

★ Excellent prospects of a good pension. If you do not qualify for a pension, then you receive a gratuity if you leave after at least 5 years' service.

Vacancies exist at RAF Sealand, near Chester, but also arise from time to time at other RAF stations throughout the country.

Applicants should apply for further information and trade test to:—

MINISTRY OF DEFENCE (CE3h(Air))
SENTINEL HOUSE
SOUTHAMPTON ROW
LONDON W.C.1

or call at No. 30 MU Sealand between the following times:—
Monday–Friday .. .. 8.30 a.m. to 4 p.m.
Saturday .. .. 8.30 a.m. to 12.30 p.m.

STAVELEY-SMITH CONTROLS LIMITED

SERVICE ENGINEERS

Vacancies exist for Marine and Industrial Electronic Service Engineers in our London (Barking), Southampton, Liverpool, Glasgow and Dublin Depot areas.

Applicants must be either ex-seagoing personnel and/or experienced Industrial Service Engineers, residential within ten miles of above depots.

All applicants must hold clean driving licence, be willing to travel and be of British birth.

All positions are Staff, with contributory Superannuation.

Apply in writing, stating experience to:—

68 Grosvenor Street, MANCHESTER, 1.

IMPORTANT ANNOUNCEMENT TO ALL ENGINEERS

Electronics Appointments Ltd. are now producing a publication designed to inform engineers of the foremost vacancies existing in the Electronics Industry.

The unique presentation of this publication enables the engineer to apply to companies on pre-paid cards addressed to the advertiser, thus ensuring a quick and effective response to the application with minimum of effort by the engineer.

A free copy of this publication—ELECTRONICS APPOINTMENTS—will be sent to your home address each month in the strictest confidence. Electronics Engineers within the age group 23-45 having a minimum qualification of H.N.C. are invited to apply for mailing registration.

ELECTRONICS APPOINTMENTS LTD.
Norman House
105-109 Strand, W.C.2

ILIFFE BOOKS

Important recent ILIFFE books for electronics technologists and students

Elements of Transistor Pulse Circuits.
T. D. Towers, M.B.E., M.A., B.A., B.Sc., Grad. I.E.R.E.
Provides the busy engineer with a practical review of the transistor version of the building bricks commonly used in pulse circuits.
35s net by post 35s 10d 168 pp. 107 illustrations.

Electrical Phenomena in Gases
R. Papoular
Deals with a complex subject in a style that is brief, concise and to the point and is suitable for both study and for reference purposes.
45s net by post 46s 1d 198 pp. 125 illustrations.

Network Analysis for Telecommunications
R. A. Lampitt, M.I.R.E.E.
An invaluable reference book for practising engineers and a textbook for students taking their degree course, professional examinations and equivalent diploma courses.
63s. net by post 64s 2d 280 pp. 135 illustrations.

Mathematical Techniques in Electronics and Engineering Analysis
J. W. Head, M.A. (Cantab.), F.Inst. P., A.M.I.E.E., F.I.M.A.
Covers the general mathematical techniques and deals with specialised applications of mathematics to problems in electrical and electronic engineering
45s net by post 46s 1d 224 pp. 67 illustrations.

Problems in Electrical Engineering for Technical Students
B. Hamill, Grad. I.E.E., A.R.T.C.S.
Specially written for the student taking the ONC in Electrical Engineering and for those studying the Electrical Science Course, C.
25s net by post 25s 11d 195 pp. illustrated.

obtainable from leading booksellers

ILIFFE Books Ltd
DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1.

ITA

TECHNICAL ASSISTANTS FOR DEVELOPMENT WORK

The INDEPENDENT TELEVISION AUTHORITY is establishing two new Sections in its Headquarters Engineering Division in Knightsbridge, London, to deal with developments in automation and colour television. Technical assistants are required for design and development work in the following fields:

(a) Semi-conductors
(b) Video and pulse circuits
(c) Data handling and computer techniques

Applicants should have at least A level in Mathematics and Physics and either a Higher National Certificate or be pursuing a recognised course in electrical engineering leading to HNC or an equivalent qualification. Previous experience in electronics is essential. A number of appointments are available and the starting salary depending on experience and qualifications is within the range £1,030-£1,470; the maximum salary for these posts is £1,690 per annum.

Excellent opportunities will occur for advancement within the Headquarters Engineering Division. Conditions of service are good and there is a contributory pension scheme.

Applicants should ask for an application form, giving brief details in the first instance to

THE PERSONNEL OFFICER, INDEPENDENT TELEVISION AUTHORITY,

70, Brompton Road, London, S.W.3, quoting reference number WW/801.

ELECTRONIC ENGINEERS

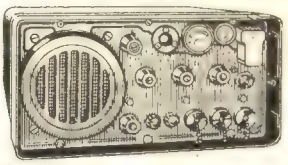
We require for our Technical Department experienced Electronic Engineers with an extensive knowledge of Tape Recorders and Radio Receivers, experience in Transistor circuits is essential. The work is varied and interesting and includes Technical investigations, the preparation of Service manuals and instructions books, customer liaison, etc. Salary by negotiation.

GRUNDIG

Applications, in writing, giving full details of experience and qualifications and salary required, should be sent to: **The Personnel Officer, Grundig (G.B.) Ltd., Sydenham, London, S.E.26.**

PORTABLE/MOBILE VHF RADIO TELEPHONE

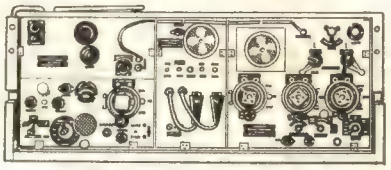
TYPE W.S.B44 MK.3



(EXPORT ONLY)

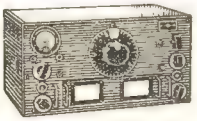
Crystal controlled 60-95 Mc/s. A modern 12 valve superhet receiver and transmitter using B7G valves. Line Up: 5-CV138, 2-CV186, 1-CV137, 1-CV140, 2-CV416, 1-CV2129. Amplitude modulation. Cast aluminium case, size 14¾in. × 12½in. × 7in. Weight 31 lbs. Built-in 5in. speaker. Output and Battery Volts Meter. Mike and phones sockets. Internal Vibrator (synchronous type) for 12 v. D.C. operation. Suitable for fixed or mobile use. Available with connecting plugs. **Price £15/10/-** (including FOB London). Each unit fully tested, and in as new condition. (Crystals for specified frequencies in the 60-95 Mc/s. range can be supplied to order at extra cost.)

MARCONI CANADIAN TRANSMITTER RECEIVER GROUND STATION No. 52



WORLD WIDE RECEPTION
★ SHIPPING ★ AMATEUR ★ BROADCAST

Comprises Receiver, Transmitter and Power Unit for 12 v. D.C. operation. Frequency coverage: 1.75-16 Mc/s. (19-170 metres) in 3 fully tunable switched wavebands. Power output 75 watts R.T.: 110 watts C.W.
PRICE ONLY £27/10/-. Carr. £2/10/- (mainland only).
Above items also available separately (less carrier).
No. 52 Receiver only **£9/19/6.** Carriage 20/-.
No. 52 Transmitter only **£9/10/-.** Carriage 20/-.
No. 52 Power Unit only **£9.** Carriage 20/-.

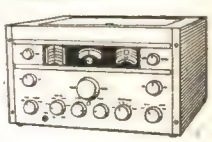


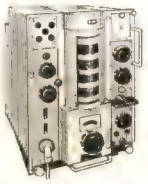
NATIONAL HRO SENIOR RECEIVERS 5T MODEL

In excellent tested condition. Available with 9 coils coverage 50 Kc/s. to 30 Mc/s. complete with PSU, **£31/10/-.** Carr. 30/-.

RCA AR88 RECEIVERS

Freq. 540 kc/s.-32 Mc/s., 6 waveband, mechanical bandspread with Logging scale, auto. and manual vol. control, ditto Noise Limiter, BFO, Pitch and Var. HF Tone controls, RF and AF Gain, Var. selectivity with Crystal Filter. Used models. Fully tested and working.
MODEL D £40. Carr. 50/-.





MURPHY B40 NAVAL RECEIVERS

5 bands 650 kc/s.-30 Mc/s. 10 valves. Built-in speaker, phones output. 2 R.F. and 3 I.F. stages, xtal bandpass filter, noise limiter, etc., etc. 150/230 v. A.C. Size 19½ × 13½ × 16in. Cost well over £500. Supplied tested working with circuit diagram. **£22/10/-.** Carr. 30/-.
Also B41, L.F. version **£15.** Carr. 30/-.
SPECIAL OFFER! Both above receivers **£30.** Carr. £3.

HALLICRAFTERS

35FT. AERIAL MASTS (*As illustrated*)
Seven 5ft. 8in. interlocking sections of 2in. dia. heavy gauge tube. Complete with swivel base plate calibrated in degrees, nylon guy lines, and ground spikes. Finished olive green. **£17/10/-.** Carr. 40/-.
ALSO 70FT. 14 sections as above plus block and tackle. **£35.** Carr. 50/-.

TELESCOPIC AERIAL MASTS. Tubular steel copperised spray finish, ring cam locking on each section provides for full or any height required. Suitable all fixings and base locations. Bottom section 1¾in. diameter. 20ft. 4 section. Closed 5ft. 9in. Weight 16lb. **60/-.** Carr. 10/-. 34ft. 6 section. Closed 6ft. 6in. Weight 20lb. **80/-.** Carr. 10/-.

ALL 19 SETS & ACCESSORIES AVAILABLE

S.A.E. All Enquiries—List 1/-

A. J. THOMPSON (Dept. WW)

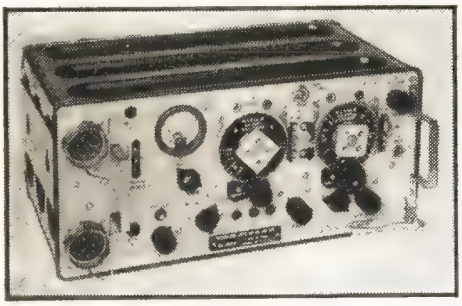
"Eiling Lodge" Codicote, Hitchin, Herts. Tel.: Codicote 242

RS RS RS RS RS RS RS symbol of quality trade only

for electronic components – by return

WW—145 FOR FURTHER DETAILS.

FAMOUS ARMY SHORT-WAVE TRANS-RECEIVER MK. III



This set is made up of three separate units:— (1) a two valve amplifier using a 6V6 output valve; (2) (some only) a V.H.F. transreceiver covering 229-241 Mc/s. using 4 valves; (3) the main short-wave Transmitter/receiver covering, in two switched bands, just below 2 Mc/s./4½ Mc/s. and 4½ Mc/s-8 Mc/s. (approx. 160-37.5 metres) using 9 valves. For RT, C.W and MCW. The receiver is superheterodyne having one R.F. stage, frequency changer, two I.F. (465 Kc/s), Signal detector, A.V.C. and output stage. A B.F.O. included for CW or single side-band reception. TX output valve 807, other valves octal bases. Many extras, e.g. netting switch, quick flick dial settings, squelch, etc. Power requirements LT 12 volts, HT receiver 275 volts D.C. HT transmitter 500 volts D.C. Size approx. 17½in. x 7½in. x 11in. Every set supplied in new or as new condition in carton with book including circuits only **£4 10s. 0d.**, or Grade 2 slightly used **50s.**, carriage both 15s.

A FULL KIT of brand new attachments for this set including all connectors, control box, headphones and mike, aerial tuning unit, co-axial lead, etc. at only **45s.**, carriage 5s. WE MAKE A MAINS 200/250 VOLT POWER UNIT in louvred metal case to plug direct into set power socket to run (1) receiver, **70s.**, post **5s.**; (2) TX and RX, **£6 10s. 0d.**, post 7s. 6d.; (3) 12 Volt D.C. input to run receiver **50s.**, carriage 5s. A charge of 10s. to unpack and test the receiver of these sets is made only if requested.

A FEW 2nd Grade sets at **£3**, carriage 15/- as above available.

V.H.F. TRANS-RECEIVER MK. 1/1

This is a modern self contained tunable V.H.F. low powered frequency modulated trans-receiver for R.T. communication up to 8-10 miles. Made for the Ministry of Supply at an extremely high cost by well-known British makers, using 15 midget B.G. 7 valves, receiver incorporating R.F. amplifier. Double superhet and A.F.C. Slow motion tuning with the dial calibrated in 41 channels each 200 kc/s apart. The frequency covered is 39 mc/s-48 mc/s. Also has built-in Crystal calibrator which gives pips to coincide with marks on the tuning dial. Power required L.T. 4½ volts, H.T. 150 volts, tapped at 90 volts for receiver. Every set supplied complete with valves and crystals. New in carton, complete with adjustable whip aerial, and circuit. **Price £4/10/-**, carriage 10/-. Headset or hand telephone **30/-**. Internal stabilised power unit for mains 200/250 A.C. **£6 10s. 0d.**

JOHN'S RADIO (Dept. F)
OLD CO-OP, WHITEHALL ROAD, DRIGHLINGTON, BRADFORD.
Tel. DRIGHLINGTON 732

VALVES

VALVE cartons by return at keen prices; send 1/- for all samples and list.—J. & A. Boxmakers. 75a, Godwin St., Bradford. 1. [116

VALVES WANTED

WE buy new valves, transistors and clean new components, large or small quantities, all details, quotation by return.—Walton's Wireless Stores, 55, Worcester St., Wolverhampton. [134

MANUFACTURERS OF ELECTRONIC EQUIPMENT

Can we assist you by manufacturing Control Panels, Assemblies, Sub-Assemblies. Long or short runs. Quality guaranteed.

Rock & Taylor Ltd., Hayes Lane Trading Estate, Lye, Worcs. *Tele:- Lye 3227/8*

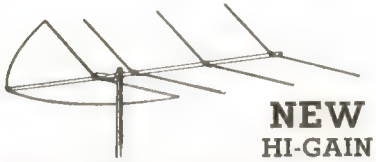
WW—146 FOR FURTHER DETAILS

CAPACITY AVAILABLE

AIRTRONICS, Ltd., for coil winding, assembly and wiring of electronic equipment, transistorised sub-unit sheet metal work.—3a, Walerand Rd., London, S.E.13. Tel. 01-852 1706. [107

SERVICES OFFERED

ELECTRONICON, Ltd.—From drawing board to production with minimum delay; let us be your research development, design and prototype department. Pilot production runs a speciality.—176, Lythalls Lane, Coventry. Tel. Nuneaton 2353 or Coventry 86544. [160



NEW HI-GAIN Export VHF/FM AERIALS for mono/stereo

- Full band width spacing
- High forward gain
- High front to back ratio
- Fibreglass moulding
- Universal clamp for up to 2½in. masts
- The perfect answer to Mono/Stereo FM reception.
- HGFM/3 3 element **60/-**
- HGFM/4 4 element **75/-** (illustrated).

Also HIGH PERFORMANCE UHF 625 COLOUR AERIALS

- Type C500 3 element **25/-**
- Type C570 7 element **32/6**
- Type C610 10 element **40/-**
- Type C 614 14 element **47/6**
- Full range of masts and fittings on request.
- State channels required when ordering
- C.W.O. or C.O.D., P.&P. 4/6.

"C" AERIALS Ltd
14-15 QUARRY ST., GUILDFORD, SURREY
Telephone Guildford 67704

WW—147 FOR FURTHER DETAILS

DINSDALE MK II AMPLIFIERS

Printed circuits and parts for mono and stereo versions. Special new power amp. printed board eliminates earth loop problems.

BAILEY 20 WATT AMPLIFIER. All parts available for this unit including Radiometal-cored Driver Transformer and recommended bi-filar wound Mains Transformer.

MULLARD 10W. A.B. TRANSISTOR AMPLIFIER. SPECIAL CLEARANCE.

Printed Circuit Boards to Mullard specification, fully drilled and fluxed. Price **4/-** each or **7/-** for two post free.

Layout Diagrams **9d.** each. All other parts available. Please send S.A.E. for all Lists.

WIRELESS WORLD DIGITAL COMPUTER

PRINTED CIRCUITS for modules and all Resistors, Capacitors and Transistors will be available as further details are released. Credit accounts are available for the convenience of bona-fide Educational establishments. Please send S.A.E. marked "W.W.COMP." for further details.

HART ELECTRONICS
321 Great Western Street, MANCHESTER 14

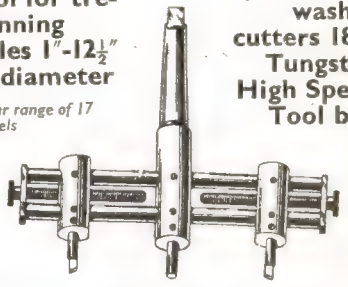
WW—148 FOR FURTHER DETAILS

ADJUSTABLE HOLE & WASHER CUTTERS

The right tool for trepanning holes 1"-12½" in diameter

In our range of 17 Models

Adjustable hole and washer cutters 18% Tungsten High Speed Tool bits



Write for illustrated brochure of our full range with straight or Morse taper 1-4 or Bitstock shank

All models available from stock

AKURATE ENGINEERING CO. LTD.
Cross Lane, Hornsey, London, N.8
TEL. FITZROY 2670

WW—149 FOR FURTHER DETAILS

LAWSON BRAND NEW TELEVISION TUBES

Complete fitting instructions are supplied with every tube.

Terms: C.W.O. Carriage and insurance 10/-.

LAWSON TUBES

18 CHURCHDOWN ROAD, MALVERN, WORCS.

Tel. MAL 2100

The continually increasing demand for tubes of the very highest performance and reliability is now being met by the new Lawson "Century 99" range of C.R.T.s.

"Century 99" are absolutely brand new tubes throughout, manufactured by Britain's largest C.R.T. manufacturers. They are guaranteed to give absolutely superb performance, needle sharp definition, screens of the very latest type giving maximum Contrast and Light output; together with high reliability and very long life.

"Century 99" are a complete range of tubes, in all sizes, for all British sets manufactured 1947-1964.

Our stocks are very large and we can supply the EXACT tube you require by return.

12"—£4 : 10 : 0
14"—£5 : 10 : 0
17"—£5 : 19 : 0
19"—£6 : 19 : 0
21"—£7 : 15 : 0

WW—150 FOR FURTHER DETAILS

GENUINE BRAND NEW PRODUCTS AT LESS THAN HALF PRICE

BRAND NEW BRITISH RECORDING TAPES—P.V.C. POLYESTER AND MYLAR, with fitted leaders in polythene and boxed, manufactured by reputable British firm, all 100% tested, not to be confused with sub-standard, imported or used tapes.

S.P.	3"	150'	2/-	5"	600'	6/-
	5½"	900'	8/-	7"	1,200'	9/-
L.P.	3"	225'	2/6	5"	900'	8/6
	5½"	1,200'	10/-	7"	1,800'	13/-
D.P.	3"	350'	4/6	5"	1,200'	12/-
	5½"	1,800'	16/-	7"	2,400'	20/-

Brand new pre-recorded beginners and brush-up courses on tape, in FRENCH, GERMAN, ITALIAN, SPANISH. Full set course of 26 lessons recorded at 3¾ i.p.s. on Scotch & E.M.I. Course lasts 1 hr. and is complete with manual, our price just **19/6**, retail 59/6.

100% TESTED TRANSISTORS

OC23	8/-	AF116 ..	4/-	AD149 ..	8/-
OC25	8/-	AF117 ..	4/-	AFZ12 ..	8/-
OC26	8/-	AF118 ..	4/-	BCY33 ..	6/6
OC28	8/-	AF119 ..	4/-	BCY34...	6/6
OC35	10/-	AF125 ..	4/-	BCY38...	6/6
OC38	12/6	AF127 ..	4/-	BCY39...	6/6
OC44	3/-	AC126 ...	4/-	BFY50 ..	5/6
OC45	3/-	AC127 ...	4/-	BFY51 ..	5/6
OC46	3/-	AC128 ...	4/-	BFY52 ..	5/6
OC70	3/-	AD140 ..	8/-	GET103..	4/-
OC71	3/-	OC169 ...	4/-	GET113..	4/-
OC72	3/-	OC170 ...	4/-	GET116..	10/-
OC75	3/-	OC161 ...	4/-	GET118..	5/-
OC78D...	3/-	OC171 ...	4/-	GET119..	5/-
OC81	3/-	OC172 ...	4/-	GET573..	5/-
OC81D ..	3/-	OC200	8/-	GET587..	5/-
OC76	3/-	OC22	8/-	GET873..	4/-
OC78	3/-	OC30	8/-	GET887..	4/6
OC82	3/-	OC36	12/6	GET889..	4/6
OC82D...	3/-	OC77	4/-	GET890..	4/6
OC84	4/6	OC83	4/-	GET896..	4/6
AF114 ..	4/-	OC123 ...	4/6	GET897..	4/6
AF115 ..	4/-	2N404 ...	6/6	GET898..	4/-

TRANSISTORS, MATCHED SETS
1 OC44+2 OC45, per set, **10/-**.
1 GET874P sleeved Yellow OC44, per set, **10/-**.
1 GET873P sleeved White OC45 1st I.F., per set, **10/-**.
1 GET873P sleeved Blue OC45 2nd I.F., per set, **10/-**.
1 OC81D+2 OC81, per set, **9/6**.
1 OC82D+2 OC82, per set, **9/6**.
OC83 GET118/119, set of 3, **9/6**.

DIODES. OA81 **4/-**, OA95 **4/-**, OA182 **4/-**, OA202 **4/-**.

SILICON DIODES
BYZ 12 (400 v. P.I.V., 6 amp.), **5/-**.
BYZ 13 (200 v. P.I.V., 6 amp.), **5/-**.

ELAC SPEAKERS, 7×4in. Price **12/6**.

4 TRANSISTOR PUSH/PULL ULTRA, Lin amplifier, 1 watt output, battery operated, designed for electronic instruments, microphones and public address. Many other uses, Price **15/6**.

CABINET TO MATCH ABOVE, 10/-.

VOLUME CONTROLS, with switch, price **3/6**.

TRANSISTORISED CAR RADIOS, normally £12/10/-. Our price **£6/19/6**.

TELESCOPIC CAR AERIALS, 3 extensions, price **17/6**.

ALL GOODS SUPPLIED CARRY OUR MONEY BACK SATISFACTION GUARANTEE

Postage on all orders 1/-.

STARMAN, 28, Linkscroft Avenue, Ashford, Middlesex Ashford 53020.

WW—151 FOR FURTHER DETAILS

PRINTED circuit tape masters, symbols to mill specification.—D. Sivers, 91, Gladstone Park Gardens, London, N.W.2. [1826

SPEEDY Injection Moulding Service. Specialist Moulders offer complete manufacturing service for Injection Moulding up to 16oz.; speedy delivery assured by well-equipped own toolroom; full service includes technical co-operation, mould design, modelling, etc.—Department 3F, Technomould Limited, Injection Moulders for the Plastic Industry, 65, Bideford Ave., Perivale, Greenford, Middx. Tel. 998 3434-5. [1823

BUSINESS OPPORTUNITIES

LONDON or South Eastern Home County company to undertake the repair of transistor and valve special purpose equipment; an oscilloscope is essential. Please apply in writing to:—Abbott, Birks & Co., Ltd., 90-91, Blackfriars Rd., London, S.E.1. [1839

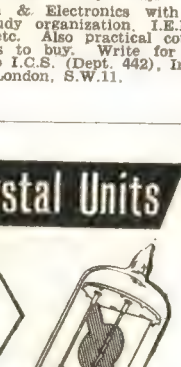
TUITION

KINGSTON-UPON-HULL Education Committee, College of Technology, Principal E. Jones, M.Sc., F.R.I.C.
FULL-TIME courses for P.M.G. certificates and the radar maintenance certificate, also in electrical and electronic engineering.—Information from College of Technology, Queen's Gardens, Kingston-upon-Hull. [154

RADIO officers see the world. Sea-going and short appointments. Trainee vacancies during 1967. Grants available. Day and boarding students. Stamp for prospectus.—Wireless College, Colwyn Bay. [128

STUDY Radio, Television & Electronics with the world's largest home-study organization. I.E.R.E., City & Guilds, R.T.E.B., etc. Also practical courses with equipment. No books to buy. Write for free prospectus stating subject to I.C.S. (Dept. 442), Intertext House, Parkgate Rd., London, S.W.11. [167

Quartz Crystal Units



For
ACCURACY
RELIABILITY
PRICE ECONOMY
you can DEPEND on

Write for illustrated Brochure & Price List

THE QUARTZ CRYSTAL CO. LTD.
Q.C.C. Works, Wellington Crescent, New Malden, Surrey (MALden 0334 & 2988)

WW—152 FOR FURTHER DETAILS

EXCLUSIVE OFFER

PERMANENT OR TRANSPORTABLE STEEL 60-FOOT AERIAL TOWERS

As supplied to British and other Governments

★ **Unique design.**
★ **Scientific Construction.**

having the following remarkable features.

★Entirely self supporting, requiring no guys, stays, foundations, pickets or spikes or any attachment to the ground.
★Fitted with step ladder to the top and balcony with railings all round (You can walk right round the top with both hands free.)
★12 feet square at base tapering to 6 feet square at top, they are quite safe when subject to gale force winds and will accept 50 square feet superficial area on top at force of 60 m.p.h. They require ground area of 20 feet square.
★Will support up to 2 tons of equipment on top, the whole tower can be completely lowered to the ground by 2 men in 20 minutes and raised in the same time.
★Can be completely erected and dismantled by 3 men.
★Breaks down for transport by 3 ton lorry into parts easily handled by 2 men, there are no small loose parts, no nuts or bolts to get lost or damaged; all screws and adjustments are fully protected from rust and so designed to be free from damage when transported or left loose on the ground.
★Foolproof—the Tower cannot be erected if not assembled correctly. No skilled labour is required and no special tools are necessary.
★Can be raised and lowered, erected and dismantled and removed as many times as desired.
★Everything necessary for the complete tower to be put into use and raised and lowered is provided; full drawings and instructions.

These fine Towers were made in England by B.I.C.C. and cost the Government £2,200 each. They are **BRAND NEW** and in maker's original packing. You can see one erected at our premises.

Cost £2,200
Price Brand New
£345

40-page list of over 1,000 different items in stock available—keep one by you.

★T-200 Panadaptors 450/470 Kcs.	£30 0
★A-1 Multi-core Cable Testers 2 Kv. —	£40 0
★Narda 500 w. Ultrasonic Cleaner	£85 0
★Sliding Shelves rack mounting	£3 0
★Magnetic Recording Wire, ¼-hr. reel	£2 0
★3M Video Recording Tape, 1in.	£5 10
★Marconi S.S.B. Receivers HR-22 2/32 mc/s	£140 0
★9 foot BC-610 Whip Aerials	£1 15
★R.C.A. 420 Mc/s. Yagi 5 el. Beams	£2 10
★Model 15 Teletype Page Printers	£29 10
★Model 14 Teletype Tape Readers	£25 0
★Model 14 Teletype Reperforators	£25 0
★R.C.A. 25 watt Projector Loudspeakers, range 1 mile	£14 10
★Metro-Vickers Vacuum Pumps 230 v. A.C.	£22 10
★Precision Mains Filter Units	10
★E.M.I. Recording Bridges	£12 10
★Avo Geiger Counters	£7 10
★Philco W.S. No. 43 Transmitters 350W	£75 0
★Metro-Vickers HS.500 Waveform Monitors	£135 0
★E.M.I. 3794 Waveform Monitors on trolleys	£45 0
★Motorola 6 v. Mobile Transmitters 30/40 Mc/s	£12 10
★Pen-type Personal Dosemeters	15
★Western Electric Relay Test Sets 1-181	£9 10
★Monitor Type 56 and Power Units	£7 10
★Marconi TF 1053 Noise Meters	£45 0
★AN/UPM-17 Spectrum Analysers 10/16000 Mc/s	P.U.R.
★AN/URM-33, 34, 35 Signal Generators 1000/8000 M/cs.	P.U.R.
★AN/PDR-27 Radiac Sets	£17 10

Carriage extra at cost on all above.

We have a large quantity of "bits and pieces" we cannot list—please send us your requirements—we can probably help—all enquiries answered.

P. HARRIS
ORGANFORD — DORSET
WESTBOURNE 65051

WW—153 FOR FURTHER DETAILS

FAIRCHILD INTEGRATED CIRCUITS

* *New low prices*

These industrial microcircuits are designed for a wide variety of industrial and commercial equipment operating over a temperature range of +15 to +55 deg. C. The operating voltage range is 3.6 v. ±10%. These ICs are similar in size to TO5 can transistors and are epoxy encapsulated with 8 leads. Full details are sent with each order, showing typical applications. The 914 gate may be used to build multivibrators, Schmitt Triggers and linear amplifiers.

THE 923 IS A FULL COUNTING FLIP-FLOP.

μL 900 BUFFER - - - PRICE 9/6
μL 914 DUAL GATE - - PRICE 9/6
μL 923 JK FLIP-FLOP - - PRICE 12/6
(AVAILABLE OCTOBER)
PLASTIC SPREADERS - - - 1/6

Terms: Cash with order.
Approved Accounts Opened.
Postage and Handling 2/-.

CROSSWIRE ELECTRONICS LTD.
STAPLE HOUSE,
51-52 CHANCERY LANE,
LONDON, W.C.2

WW—154 FOR FURTHER DETAILS

R & R RADIO

51 Burnley Road, Rawtenstall
Rossendale, Lancs
Tel.: Rossendale 3152

Drive in safety, see and be seen, Dimmed beam lighting units, contents, 12 volt relay, FZS 70 diode, 1 ohm 30 watt res., cable connectors and fixing bracket. Price 12/6, post 1/-, fitting instructions supplied. Emergency flasher unit, switch on in the event of a breakdown to warn other road users, complete kit comprising 12 volt relay, resistors, connectors, switch, indicator-light and dash fitting escutcheon. Price 17/6, post 1/-.
B.B.C or V.H.F. indoor dipoles, complete with 6ft. of cable 75 ohm, 5/-, post 1/-.
Wire ended neons, strike 80 volt, 1/6, post paid.
5 inch round speakers 3/6; 6 x 4 3/6; 8 inch 6/-, post 4/6.
Fireball tuners in good condition, 17/6, post 2/6.

RECEIVER, TYPE 1933A

A compact 20 valve, crystal controlled receiver of modern manufacture, in metal case. Size 12in. × 8in. × 4in. Consisting of main double-sided chassis and front panel with 5 plug-in sub-chassis. I.E., R.F. amplifier type 478, I.F. amplifier type 479, Osc. amplifier type 477, A.M. and F.M. demodulator type 1 and A.F. amplifier type 480. All connections are brought out to Plessey sockets on front panel and are connected by flexible lead (not supplied) to the control box type 381, which provides a pre-selector and tunable frequency range of 66-77 Mc/s. Both units are in new condition and offer possibilities for conversion to 4-metre band complete with circuit diagram.
Price £4/10s., postage 10/6.

New catalogue No. 17
Government and Manufacturers' surplus, 3/- Post Free.

RADIO CONTROL
Phone BRIGHTON 65806
ARTHUR SALLIS RADIO CONTROL LTD.
93 NORTH ROAD BRIGHTON SUSSEX
EX GOVT ELECTRICAL SURPLUS

ELECTRIC TIME SWITCHES

MADE BY SIEMENS, 200/250 A.C. with 10 amp. Contacts. Once ON Once OFF every 24 hours at any manually pre-set times. Used but perfect and fully guaranteed. Wiring instructions supplied. With metal case—no lid—7/6 extra. 39/6 P.P. 3/-
VENNER 40-DAY CLOCKWORK TIME-SWITCH. in metal case. 0·1 amp. rating. Switches on every half hour for adjustable periods from three to thirty seconds. Size 7½in. × 6in. × 4½in. 45/- P.P. 4/6
OTHER TYPES IN STOCK. WRITE FOR DETAILS.
ELECTRIC WATT. HOUR METERS.
Ferranti 25 amp. 29/6. P.P. 4/6.
Sangamo Weston 40 amp. 35/-. P.P. 4/6.
Box 365, KINGSWOOD SUPPLIES (W.W.5),
4 Sale Place, London, W.2. 01-723 8189

I.E.R.E., City & Guilds and R.T.E.B. exams.: specialised I.C.S. home-study course will ensure success; for details of wide range of exam. and diploma courses in radio, TV and electronics, also new practical courses with kits, write to:—I.C.S. (Dept. 522), Parkgate Rd., London, S.W.11. [171

ALDERMASTON Court Postal Training for B.Sc. (Eng.) Part 1, A.M.I.E.R.E., A.M.S.E., City & Guilds, G.C.E., etc., prepares you privately for high pay and security as Technician or Technologist, thousands of passes. For details of exams and courses in all branches of Engineering, Building, Electronics, etc. (including latest information on C.Eng.), write for 132-page handbook—free; please state interest.—British Institute of Engineering Technology (Dept. 151K), Aldermaston Court, Aldermaston, Berks. [147

TV and Radio, City & Guilds, R.T.E.B. Certs., etc., on "satisfaction or refund of fee" terms, thousands of passes. For full details of exams and home training courses (including practical equipment) in all branches of radio, TV, electronic, etc., write for 132-page handbook—free; please state subject.—British Institute of Engineering Technology (Dept. 150K), Aldermaston Court, Aldermaston, Berks. [148

TEST EQUIPMENT — SURPLUS AND SECONDHAND

SIGNAL generators, oscilloscopes, output meters, wave voltmeters, frequency meters, multi-range meters, etc., etc., in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd,. London, E.11. Ley. 4986. [141

RECEIVERS AND AMPLIFIERS — SURPLUS AND SECONDHAND

HRO Rx5s, etc., AR88, CR100, BRT400, G209, S640, etc., etc., in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [142

TECHNICAL TRAINING

P.M.G. Certificates, City & Guilds and I.E.R.E. Examinations. Also many non-examination courses in Radio, TV and Electronics. Study at home with world famous I.C.S. Write for free Prospectus stating subject to—International Correspondence Schools (Dept. 443), Intertext House, Parkgate Rd., London, S.W.11. [168

DAMAGED METER?

Have it repaired by Glaser

Reduce overheads by having your damaged Electrical Measuring Instruments repaired by L. Glaser & Co. Ltd. We specialise in the repair of all types and makes of

INSTRUMENT REPAIRS

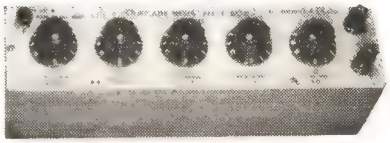
Voltmeters, Ammeters, Microammeters, Multirange Test Meters, Electrical Thermometers, Recording Instruments, Leak Detectors, Temp. Controllers, all types Bridges & Insulation Testers, etc.

As contractors to various Government Departments we are the leading Electrical Instrument Repairers in the Industry. For prompt estimate and speedy delivery send defective instruments by registered post, or write to Dept. W.W.:—

L. GLASER & CO. LTD.
1-3 Berry Street, London, E.C.1
Tel.: Clerkenwell 5481-2

WW—155 FOR FURTHER DETAILS

R, C & L BOXES

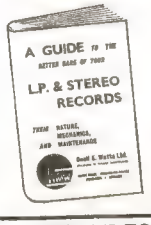


CAPACITY 15pf to 111μF
RESISTANCE 0.1Ω to 100KΩ
INDUCTANCE 1mH to 10H
VOLTAGE DIVIDERS and
WHEATSTONE BRIDGES

LIONMOUNT & CO. LTD.
BELLEVUE ROAD, NEW SOUTHGATE,
LONDON, N.11, ENGLAND
Tel: Enterprise 7047,

WW—156 FOR FURTHER DETAILS

Watts



THE ONLY COMPREHENSIVE RANGE OF RECORD MAINTENANCE EQUIPMENT IN THE WORLD!

Send stamps value 9d. for 16 page booklet and supplementary data sheet Nos. 1 and 4 giving the fullest and latest information.

CECIL E. WATTS LIMITED
Darby House
Sunbury-on-Thames, Middx.

WW—157 FOR FURTHER DETAILS

MOTOROLA INTEGRATED CIRCUITS

LATEST LOW PRICE DUAL IN LINE

MC715P	—	DUAL 3-INPUT GATE	—	19/6 Ex Stock.
MC724P	—	QUAD 2-INPUT GATE	—	17/6 Delivery October.
MC725P	—	DUAL 4-INPUT GATE	—	17/6 Ex Stock.
MC789P	—	HEX INVERTER	—	19/6 ,, ,,
MC792P	—	TRIPLE 3-INPUT GATE	—	19/6 ,, ,,
MC799P	—	DUAL BUFFER	—	17/6 ,, ,,
MC788P	—	DUAL BUFFER (NON-INV)	—	22/6 ,, ,,
MC723P	—	J-K FLIP FLOP	—	17/6 ,, ,,
MC790P	—	DUAL J-K FLIP FLOP	—	29/6 (i.e. 14/9 per JK)

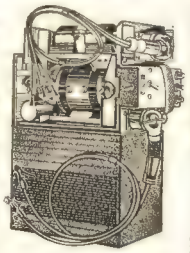
Postage and handling 2/-.

Crosswire Electronics Ltd.,

STAPLE HOUSE, 51 - 52, CHANCERY LANE, LONDON W.C.2.

WW—158 FOR FURTHER DETAILS

INSTANT ELECTRICITY ANYWHERE!



AMAZING NEW AMERICAN DYNAMOTOR UNIT which runs from any 12-v. CAR BATTERY and produces a BIG ELECTRICAL OUTPUT of 230/240 v. at 220 watts. Marvellous for TELEVISION, ELECTRICAL DRILLS, MAINS LIGHTING and all Universal AC/DC mains equipment. Wonderful for A.C. FLUORESCENT LIGHTING. ONLY £12/10 - plus 30/- carr. Send stamped addressed envelope for illustrated details. Open 7 days a week.

SCIENTIFIC PRODUCTS (Dept. H)

Onward Building (rear of Fleetwood Arms Hotel), Mount Street, Fleetwood, Lancs.

WE OFFER a large range of Patterns of

TRANSFORMER LAMINATIONS

in RADIOMETAL, MUMETAL and H.C.R.

Stocks of most patterns available.
Please send for list.

ALSO AVAILABLE "C" & "E" CORES, CASE AND FRAME ASSEMBLIES

J. BLACK

44, GREEN LANE, HENDON, N.W.4

Phone : SUNnyhill 1855 & 3033.

YUKAN SO PROFESSIONAL THE YUKAN SELF-SPRAY AEROSOL WAY

Get these AIR DRYING GREY HAMMER or BLACK WRINKLE (CRACKLE) finishes

Yukan Aerosol spraykit contains 16 ozs. fine quality durable easy instant spray. No stove baking required. Hammers available in grey, blue, gold, bronze. Modern Eggshell Black Wrinkle (Crackle) all at 14/11 at our counter or 15/11, carriage paid, per push-button self-spray can. Also Durable, heat and water resistant Black Matt finish (12 ozs. self-spray cans only) 13/11 carriage paid.

SPECIAL OFFER : 1 can plus optional transferable snap-on trigger handle (value 5/-) for 18/11, carriage paid. Choice of 12 selfspray plain colours and primer (Motor car quality) also available.

Please enclose cheque or P.O. for total amount to :

Other Yukan Air Drying Aerosols include:
Zinc Chromate Primer.
Clear Lacquer.
Anti-Tarnish Gold
and Metallic Finishes.

YUKAN, Dept WW 9,
307a EDGWARE ROAD,
LONDON, W.2.
Open all day Saturday. Closed Thursday afternoons.

CITY & GUILDS (Electrical, etc.) on "Satisfaction or Refund of Fee" terms. Thousands of passes. For details of modern courses in all branches of electrical engineering, electronics, radio, T.V., automation, etc., send for 132-page handbook—free.—B.I.E.T. (Dept. 152K), Aldermaston Court, Aldermaston, Berks. f146

BECOME "Technically Qualified" in your spare time. guaranteed diploma and exam. home-study courses in radio, TV, servicing and maintenance. R.T.E.B., City & Guilds, etc., highly informative 120-page Guide—free.—Chambers College (Dept. 837K), 148, Holborn, London, E.C.1. f166

TRANSISTOR

SPECIFICATION & SUBSTITUTION HANDBOOK

New 1967 Ed. By Tec-Press 21/- P. & P. 1/-.

RADIO HANDBOOK, by W. Orr, New 17th ed. Pub. by Editors and Engineers 84/-. P. & P. 4/6.

BASIC T.V. PART I. Common Core series. 21/-. P. & P. 1/-.

TRANSISTOR ELECTRONIC ORGANS FOR THE AMATEUR, by Astley. 16/-. P. & P. 1/-.

TRANSISTORS IN LOGICAL CIRCUITS, by Altes. 16/-. P. & P. 1/-.

CIRCUITS FOR AUDIO AND TAPE RECORDING, by Judd. 7/6. P. & P. 9d.

SILICON CONTROLLED RECTIFIERS, by Lytel. 21/-. P. & P. 1/-.

HOW TO LISTEN TO THE WORLD. New ed., by Johansen. 26/-. P. & P. 1/-.

PAL COLOUR T.V. SYSTEM, by Mullard. Circuits described. 12/6. P. & P. 1/3.

Where possible 24-hour service guaranteed.

UNIVERSAL BOOK CO.

12 LITTLE NEWPORT ST., LONDON W.C.2

(Leicester Square Tube Station)

TO ALL

Manufacturers, Wholesalers, Importers, etc. of the Radio and Electronic Industries

We are spot cash purchasers for all types of redundant and surplus stocks.

Phone or write Hillside 2713
Stonegrove 7624

Broadfields Disposals Ltd.,
8, Broadfields Avenue,
Edgware, Middx
or
Mayco Products Ltd.,
21 Lodge Lane,
N. Finchley, N.12

RESISTANCE WIRES

EUREKA-CONSTANTAN

Most Gauges Available

NICKEL-CHROME MANGANIN
NICKEL-SILVER

COPPER WIRE

ENAMELLED, TINNED, LITZ, COTTON AND SILK COVERED

SMALL ORDERS PROMPTLY DESPATCHED
B.A. SCREWS, NUTS, WASHERS
soldering tags, eyelets and rivets
EBONITE and BAKELITE PANELS.
TUFNOL ROD, PAXOLIN TYPE COIL FORMERS AND TUBES. ALL DIAMETERS
SEND STAMP FOR LIST. TRADE SUPPLIED

POST RADIO SUPPLIES

33 Bourne Gardens, London, E.4

TELEPHONE 01-254-4688.

TRAIN TODAY FOR TOMORROW

Start training TODAY for one of the many first-class posts open to technically qualified men in the Radio and Electronics industry. ICS provide specialized training courses in all branches of Radio, Television and Electronics—one of these courses will help YOU to get a higher paid job. Why not fill in the coupon below and find out how?

Courses include:

- RADIO/TV ENG. & SERVICING
- AUDIO FREQUENCY
- CLOSED CIRCUIT TV
- ELECTRONICS—many new courses
- ELECTRONIC MAINTENANCE
- INSTRUMENTATION AND SERVOMECHANISMS
- COMPUTERS
- PRACTICAL RADIO (with kits)
- NEW PROGRAMMED COURSE ON ELECTRONIC FUNDAMENTALS

Guaranteed Coaching for:

- Inst. Electronic & Radio Engs.
- C. & G. Telecom. Techns' Certs.
- C. & G. Supplementary Studies
- R.T.E.B. Radio/T.V. Servicing Cert.
- Radio Amateur's Examination
- P.M.G. Certs. in Radiotelegraphy
- General Certificate of Education

Start today - the ICS way

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. 230 Parkgate Rd., London, S.W.11.

Please send FREE book on

.....

Name .....

Address .....

.....

..... 9.67

WW—159 FOR FURTHER DETAILS

WANTED. Your redundant or surplus stocks of Transformer Laminations, "C" Cores, Enamel Copper Wire, Transistors and Diodes.

GOOD PRICES PAID.

J. BLACK

44 GREEN LANE, HENDON, N.W.4.

Phone: SUNnyhill 1855 & 3033.

HAMMERITE HAMMER PATTERN BRUSH PAINT FOR PANELS, METALWORK, ETC.

TRIAL TIN (covers 5 sq. ft.) only **3'6** + 9d. post.

AIR DRYING. JUST BRUSH ON. WITHSTANDS 150°C, oil water, etc. COLOURS: Blue, silver, black, bronze (tinters available). 2½ oz. tins **3/6**; ½ pint **7/6**; 1 pint **15/-**; carr. up to 5/-, 9d up to 10/-, 1/9; over 10/-, 3/-. Very special prices for larger sizes. Return of post service. Fireproof thinners, transfers etc. List free. AMAZING RESULTS. JUST TRY IT!

FINNIGAN SPECIALITY PAINTS (W) Mickley Square, Stocksfield, Northumberland. Tel: Stocksfield 2280

WW—160 FOR FURTHER DETAILS

SPECIALIST SUPPLIERS IN ELECTRONICS, AUTOMATION AND ELECTROMECHANICS

SERVO & ELECTRONIC SALES LTD.

43, High Street, Orpington, Kent. (Technical enquiries.) Tels.: Orpington 31066, 33976

67, London Road, Croydon, Surrey. (Main counter sales branch.) Tel.: 01-688-1512

Mill Road, Lydd, Kent. (Routine orders.) Tel.: Lydd 252

A.C./D.C. 3-Digit Digital Voltmeters 0-250V A.C., 0-1,000V D.C. £92/10/-

Write for full specification and a copy of our Servo and General Cat.

WW—161 FOR FURTHER DETAILS

DEIMOS LTD

TAPE RECORDERS FOR RESEARCH, INDUSTRY AND PROFESSIONAL AUDIO

single and multichannel

8 CORWELL LANE, HILLINGDON, MDX.

HAYes 3561

WW—162 FOR FURTHER DETAILS

HEATHKIT

The World's largest manufacturers of

ELECTRONIC KITS

We invite you to visit our showrooms at **233 TOTTENHAM CT. RD., LONDON, W.1.** Telephone 01-636-7349.

Send for free catalogue, Dept. TC5

WW—163 FOR FURTHER DETAILS

REDUNDANT OR SURPLUS RADIO — ELECTRONIC STOCKS WANTED

OSMABET LTD.

46 KENILWORTH ROAD, EDGWARE, MIDDX.

TEL: STONEGROVE 9314

WW—164 FOR FURTHER DETAILS

NEONS. PRINTED CIRCUIT BOARDS. INSTRUMENT CASES. MOULDED REED SWITCHES. CONTIL and BRIGHTLIFE products are all ex-stock. For details see June, 1967; August, 1967; October, 1967 issues, advertisements. For further details use reader service card.

PIDAM LOGIC MODULES. See August, 1967, or write direct.

WEST HYDE DEVELOPMENTS LIMITED, 30 HIGH STREET, NORTHWOOD, MIDDX.

Telephone: Northwood 24941

WW—165 FOR FURTHER DETAILS

BI-PAK-PRE-PAK-VALUE PAKS

NEW - UNTESTED DEVICES - NEW

120	Glass Sub-Min.	GERM. DIODES	10/-
50	Mixed Germ.	TRANSISTORS	10/-
20	Mixed Volts	ZENERS	10/-
30	NPN, PNP, MIXED	SILICON TRANS.	10/-
60	200mA Sub-Min.	SILICON DIODES	10/-
20	Germ. 1 Amp.	RECTIFIERS	10/-
40	Like OC81 AC 128	TRANSISTORS	10/-
10	2 Amp. Stud	SIL. RECTIFIERS	10/-
25	Sil. NPN, 200 Mc/s	TRANSISTORS	10/-
16	Top-Hat 750 mA	SILICON RECT.	10/-
75	GERM. DIODES	GOLD BONDED	10/-

BI-PAK EXCLUSIVE-SILICON TRANS.

300 Mc/s NPN Planar Sim. 2N706

Price	2/-	1/9	1/6	1/3	1/-
Qty.	1–24	25–99	99–499	500–999	1000 up

SILICON PLANAR DIODES 1/- (1–99); 10d. (100–499) 60 P.I.V. 200 mA, Sub-min. 9d. (500–999); 7d. (1000 up) ALL BRAND NEW—TESTED AND GUARANTEED. Full Data and List of possible Replacements available.

NEW SILICON RECTIFIERS TESTED

PIV	750 mA	3 AMP	10 AMP	30 AMP
50	2/-	3/-	4/6	9/6
100	2/3	3/6	6/-	15/-
200	2/6	4/6	6/6	20/-
300	3/-	4/9	8/-	22/-
400	3/6	6/-	9/-	25/-
500	4/-	6/6	9/6	30/-
600	4/3	7/-	10/-	37/-
800	4/9	8/-	15/-	40/-
1000	6/-	10/-	17/6	50/-

750 mA TOP-AT TYPE 3, 10 and 30 A STUD TYPE

★ TESTED NEW VALUE-PAKS ★

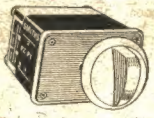
16 Red Spot AF transistors, PNP	10/-
16 White Spot RF transistors, PNP	10/-
3 OC71 Trans. Mullard	10/-
8 OA81 Diodes CV448 type	10/-
2 200 Mc/s Trans. BSY27	10/-
4 2G471 Trans RQVT AF117	10/-
4 OA202 Silicon Diodes Sub-Min.	10/-
2 Power Trans. OC28/35	10/-
4 OA10 Diodes, Mullard	10/-
6 Matched Trans. OCC44/45/81/81D	10/-
4 Sil. Rect. 100-400 PIV, 3 amp.	10/-
2 2N697 Sil. Trans. Planar	15/-
1 2N2160 Unijunction Trans.	15/-
1 Tunnel Diode 1N3720	15/-
1 Power Trans. Sil. 100 Mc/s TK201A	15/-
6 BY100 Type Sil. Rect. 800 PIV .550mA	20/-

Min. Oorder 10/-. C.W.O. Please add 1/- Post and Packing.

Over 150 Pre-Pak Semiconductor bargains incl. Integrated Circuits, Tunnel Diodes, S.C.R.s & Photo Device: plus "FREE" offers. For full details send 6d. in stamps.

BI-PAK SEMICONDUCTORS

8 RADNOR HOUSE, 93-97 REGENT ST., LONDON W.1. MAIL ONLY



SMITHS PRECISION SIX MINUTE DELAY ACTION SWITCH

Clockwork actuated

10/6 EACH Post 2/6 (3 or more post free).

Separate switching up to 6 mins, 15 amps. 250 volts. MADE FOR ROLLS WASHERS. Ideal photographic timer, sequence switching operations, etc., etc. Brand new units at a fraction of their value.

T.V. REMOTE CONTROL

For Philips 19TG111A, 121A, 122, 123, 123TG111A, 113A, 121A, 131A, Stella ST1033A; 39A, 43A, 53A. Cossor CT1910A, 21A, CT2310A, 21A, 31A. Philips Price 3 gns.

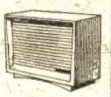
OUR PRICE **12/6** Post 2/6

GARRARD GRAM MOTORS

COMPLIES B.S.S. 170.
2 POLE INDUCTION MOTOR, 2,500 r.p.m.
115 v. A.C. For models, fans, etc.
15/- pair for 230 v. in series. Post 2/6.

TRANSISTOR BOOSTER— DOUBLE YOUR VOLUME!

Cream plastic cabinet speaker with 20ft. lead for transistor radio, intercom, mains radio, tape recorder. Size: 7½in. x 5½in. x 3in. **30/-** Post 2/6



THE INSTANT BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER

200/250 A.C. Leaflet S.A.E. **35/-** Post 2/6

SPECIAL OFFER! **BRAND NEW B.A.S.F. TAPES**
60 min. Cassette C60 *(For Philips etc.)* 17/6
7 in. L.P. 1,800 ft. (Cat. LGS35) 45/- Post 2/6—3 or more post free.
7 in. D.P. 2,400 ft. (Cat. LGS26) 70/-

RADIO COMPONENT SPECIALISTS
337 WHITEHORSE RD., CROYDON Tel: 01-684-1665

SALE OF SURPLUS SECONDHAND EQUIPMENT

A Sale of Surplus Secondhand Test Equipment, Signal Generators, Test Sets, Various Units and Chassis, Components, Relays, Certain Valves and Tubes, will take place at **Z. & I. AERO SERVICES LTD., 44A, WESTBOURNE GROVE, W.2,** on Saturday, 30th September, from 9 a.m. to 6 p.m. Nearest tube stations Bayswater and Royal Oak.

ONE DAY ONLY

WW—166 FOR FURTHER DETAILS

CURSONS TRANSISTORS

ALL GUARANTEED

1/- each. BAY31, BAY50, DK10, OA70, OA81.

2/- each. XA101, XA102, OC71, OC72, OC81, OC81D, OC44, OC45, GET16.

3/- each. OC139, OC140, 2N706, 2N708, 2N2894, BY100, RAS310AF, 2N914, BSY26, BSY27, BSY95A, AFZ12.

7/6 each. RAS308AF, CRS3/40, BLY10, BLY11, BUY10, BUY11, ADY22, ADY23, ADY24.

ZENER DIODES

3.9 v. to 26 v., ¼ w. 3/6 each; 1.5 w. 5/-; 7 w. 6/- ea.

CURSONS,
78 BROAD STREET, CANTERBURY, KENT.

WW—167 FOR FURTHER DETAILS

BARGAIN PARCELS

ANY 15 VALVES 24/-, ANY 50 70/-. From the following list:—PCF80, PCC84, PL81, PY81, PY800, PY82, PL36, PY32, ECL80, EB91, EF80, EB91, 30P4, PCL82, PCL83, 30FL1, 6-30L2, EY86, ECC82, 10F1, All Valves Set, Tested. P. & P. 2/-. 3-BY100 Type Rectifiers with Surge Resistors and Tag Strips, 10/-

VELCO ELECTRONICS
49 Bridge Street, Ramsbottom, Bury, Lancs.

WW—168 FOR FURTHER DETAILS

BOOKS

"RADIO Designer's Handbook." Editor, F. Langford-Smith, B.Sc., B.E., Senior Member I.R.E. (U.S.A.), A.M.I.E. (Aust.), a comprehensive reference book, the work of 10 authors and 23 collaborating engineers, containing a vast amount of data in a readily accessible form; the book is intended especially for those interested in the design and application of radio receivers or audio amplifiers. Television, radio transmission and industrial electronics have been excluded in order to limit the work to a reasonable size. 65/- net from all booksellers. By post 67/9 from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

"ULTRASONIC delay Lines." C. F. Brockelsby, B.Sc., A.R.C.S., A.M.I.E.E., J. R. Palfreeman, R. W. Gibson, B.Sc. (Eng.), Grad. I. Mech. E. The authors are members of a team which has been working on ultrasonic delay lines, since the early days, at the Mullard Research Laboratories. This is the first book to be written specifically on the subject, which has important applications in radar, radio and television, electronic computers, pulse-forming networks, correlation techniques and multi-channel communication systems. The early chapters discuss basic principles and the various type of delay lines are then covered. The chapter on electronics for delay lines deals fully with the design of broad-band amplifiers, oscillators, etc., either with transistors or valves. The last two chapters are devoted to the delay line measurements and the many applications of delay lines. Among the five appendices there is one containing nearly 60 curves which give the characteristics of many delay line materials. The final appendix discusses one of the latest developments, ceramic transducers, 65/- net, 66/3 by post.

NEW RESISTORS REDUCED PRICES!

Carbon film, low noise. Large quantities stocked. ¼W. 10%, 1/9 doz., 13/6 100, 12/- 100 of one value. ½W. 5%, 2/- doz., 16/- 100, 14/6 100 of one value. 4.7Ω to 10MΩ to your choice, E.12 series only. Skeleton Pre-sets: 100, 250, 500Ω, etc. to 10MΩ, horizontal or vertical mounting, 1/- each.
TRANSISTORS: 2N3055, £1; BFY50, 7/6 each.

ELECTROVALUE
6, Mansfield Place, Ascot, Berkshire.

WW—169 FOR FURTHER DETAILS

"ABACS of Nomograms." By A. Giet. Translated from the French by H. D. Phippen and J. W. Head. Most engineers have made use of nomograms at some time in their careers, and are fully alive to the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use. Most of the comparatively small literature on the subject is written for mathematicians and is extremely difficult for the practical engineer to comprehend. This book is essentially practical and not only demonstrates the many and varied applications of the abac of nomogram, but shows how even those without highly specialized mathematical knowledge may construct their own charts. 35/- net from all booksellers. By post 36/- from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

"TELEVISION Engineering Principles and Practice, vol. III. Waveform Generation," by S. W. Ames, B.Sc.(Hons.), A.M.I.E.E., and D. C. Birkinshaw, M.B.E., M.A., M.I.E.E. The third volume of a comprehensive work on the fundamentals of television theory and practice, written primarily for the instruction of BBC engineering staff. This volume gives the application in television and sinusoidal, rectangular, sawtooth and parabolic waves and shows the mathematical relationship between them. The main body of the text is devoted to the fundamental principles of the circuits commonly used to generate such signals, the treatment being largely descriptive in nature and therefore less mathematical than that of the previous volume. The work is intended to provide a comprehensive survey of modern television principles and practice. 30/- net from all booksellers. By post 31/- from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

EX-GOVERNMENT EQUIPMENT BARGAINS

Brand new 100v. Meggers in leather case	£15	15	0
A.R.88 Receivers, Type D	£65	0	0
A.R.88 Receivers, Type L.F.	£45	0	0
Signal Generators, Marconi. T.F. 144G. Tested. Complete. Spares. In transit case	£32	10	0
Signal Generator. AVO portable. As new. Tested	£18	0	0
Wavemeter. Class D. No. 2. Brand new. Complete station. Manual and charts. Tested	£30	0	0
Oscilloscopes. Various. As new. From £22/10/- to Carriage extra	£40	0	0

Send details of requirements with S.A.E. and 6d. for lists.
ELVIN NAYLOR, 214 *Hornsinglow Road, Sheffield, 5*

WW—170 FOR FURTHER DETAILS

LONDON CENTRAL RADIO STORES

MODERN HAND SETS with coiled lead, grey, white and black, **22/6.** P.P. 3/-.

TELEPHONE COILED HAND SET LEADS, 3 core 5/6. P.P. 1/-.

MODERN DESK PHONES, 2 tone grey or black, with internal bell and handset with 0-1 dial, **£4/10/-.** P.P. 7/6.

10-WAY PRESS-BUTTON INTER-COM TELEPHONES in Bakelite case with junction box handset. Thoroughly overhauled. Guaranteed. **£6/10/-** per unit.

20-WAY PRESS-BUTTON INTER-COM TELEPHONES in Bakelite case with junction box. Thoroughly overhauled. Guaranteed. **£7/15/-** per Unit.

WIRELESS SET No. 38 A.F.V. Freq. range 7.3 to 9.0 Mc/s. Working range ¼ to 2 miles. Size 10½ × 4 × 6½in. Weight 6½lb. Includes power supply 8lb—and spare valves and vibrator also tank aerial with base. **£6** per pair or **£3** single. P.P. 25/-.

ELECTRICITY SLOT METERS (1/- in slot) for A.C. mains. Fixed tariff to your requirements. Suitable for hotels, etc. 200/250 v. 10 A. **80/-.** 15 A. **90/-.** 20 A **100/-.** P.P. 7/6. Other amperages available. Reconditioned as new, 2 years guarantee.

QUARTERLEY ELECTRIC CHECK METERS. Reconditioned as new. 200/250 v. 10 A. **42/6;** 15 A. **52/6;** 20 A. **57/6.** Other amperages available. 2 years guarantee.

TWIN GONG TELEPHONE, extension bells, **21/-.**
P.M. MOVING COIL SPEAKERS, 5in. **9/6;** 8in. 3 ohm **10/6.** Elliptical 7 × 4in. 3 ohms **10/6.** P.P. 3/6.

8-BANK UNISELECTOR SWITCHES. 25 contacts, alternate wiping **22/15/-;** 8 bank half wipe **22/15/-;** 6 bank half wipe, 25 contacts **47/6.** P.P. 3/6.

DESK PHONES. Black Bakelite cases, complete with hand set and internal bell with 0-1 dia. **42/6.** P.P. 6/-.

HIGH-SPEED ELECTRO-MAGNETIC COUNTERS. Ex-Govt. 4 digit. 25/50 v. D.C. Size 4 × 1 × 1in. Single coil, 2,300Ω. Single coil 500Ω, **8/6.** P.P. 3/6.

EX GOVT. BALANCED ARMATURE THROAT MIKES complete with plug, new. **7/6.** P.P. 3/6.

DESK PHONES from **35/-.** Various types in stock. Final End Selectors. Relays, various callers, also 19 Receivers in stock. All for callers only.

23 LISLE ST. (GER 2969) LONDON W.C.2
Closed Thursday 1 p.m. **Open all day Saturday**

SURPLUS HANDBOOKS

19 set Circuit & Notes	4/6	p/p 6d
1155 set Circuit & Notes	4/6	p/p 6d
H.R.O. Technical Instructions	3/6	p/p 6d
38 set Technical Instructions	3/6	p/p 6d
46 set Working Instructions	3/6	p/p 6d
88 set Technical Instructions	5/-	p/p 6d
BC.221 Circuit & Notes	3/6	p/p 6d
Wavemeter Class D Techn. Ins.	3/6	p/p 6d
18 set Circuit & Notes	3/6	p/p 6d
BC.1000 (31 set) Circuit & Notes	3/6	p/p 6d
CR.100/B28 Circuit & Notes	3/6	p/p 6d
R.107 Circuit & Notes	5/-	p/p 6d
A.R.88D Instruction Manual	15/-	p/p 1/6d
62 set Circuit & Notes	4/6	p/p 6d
52 set Sender and Receiver Circuits	6/-	post free

Circuit Diagrams 3/- each, post free.
R.1116/A, R.1224/A, R.1355, RF.24, 25 & 26, A.1134, T.1154 C.R.300, BC 342, BC 348J, E.M.P. 'B,' BC624, 22 SET.
Resistor Colour Code Indicator, 1/6, p/p 6d.
Postage rates apply to U.K. only.
Mail order only to:
INSTRUCTIONAL HANDBOOK SUPPLIES, Dept. W.W.
TALBOT HOUSE, 28 TALBOT GARDENS, LEEDS, 8.

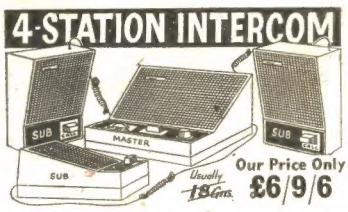
WW—171 FOR FURTHER DETAILS

SEMI CONDUCTOR BARGAINS

Type	*Price*	*Type*	*Price*	*Type*	*Price*	*Type*	*Price*
OC22	8/-	OC81	3/-	ACY19	4/-	BCY38	6/6
OC23	8/-	OC81D	3/-	ACY20	5/6	BFY50	5/6
OC24	8/-	OC82	3/-	ACY21	5/6	BFY51	5/6
OC25	8/-	OC82D	3/-	ACY22	4/6	BFY52	5/6
OC26	8/-	OC83	4/-	ACY28	4/6	BFY53	6/6
OC28	8/-	OC84	4/6	AD140	8/-	BY100	4/6
OC30	8/-	OC123	4/6	AD149	8/-	BYZ12	8/-
OC35	10/-	OC170	4/-	AF114	4/-	BYZ13	6/6
OC36	12/6	OC171	4/-	AF115	4/-	GET103	4/-
OC38	12/6	OC172	4/-	AF116	4-	GET113	4/-
OC44	3/-	OC202	8/-	AF117	4/-	GET116	10/-
OC45	3/-	OC205	8/-	AF118	4/-	GET118	4/6
OC46	3/-	OA81	2/-	AF125	4/-	GET119	4/6
OC70	3/-	OA95	2/-	AF127	4/-	GET887	4/6
OC71	3/-	OA182	2/-	AFZ12	8/-	GET889	4/6
OC72	3/-	OA202	2/-	ASY55	5/-	GET890	4/6
OC75	3/-	AC107	8/-	ASY58	5/-	GET896	4/6
OC76	3/-	AC126	4/-	BCY10	6/6	GET897	4/6
OC77	4/-	AC127	4/-	BCY12	6/6	GET898	4/6
OC78	3/-	ACY17	4/-	BCY33	6/6	BC107	8/-
OC78D	3/-	ACY18	4/-	BCY34	6/6		

Unmarked, Untested Transistors 60 for **10/-.**
All fully tested and guaranteed. Discount for quantity, orders available on request. Post and packing 1/- per order.
A. MARSHALL & SON (LONDON) LTD. (Dept. W.W.10.)
28 Cricklewood Broadway, London, N.W.2. Tel.: 01-452 0161

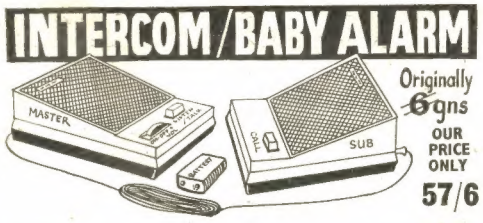
4-STATION INTERCOM



Usually 18 gns. Our Price Only £6/9/6

Solve your communication problems with this new **4-Station Transistor Intercom** system (**1 master** and **3 subs**), in de luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs** to **Master.** Operates on one 9 v. battery. On/off switch. Volume control. Ideally suitable to modernise Office, Factory, Workshop, Warehouse, Hospital, Shop, etc., for instant inter-departmental contacts. Complete with 3 connecting wires, each 66ft. and other accessories. Nothing else to buy. P. & P. 6/6 in U.K.

INTERCOM/BABY ALARM



Originally 6gns OUR PRICE ONLY 57/6

Same as 4-Station Intercom for two-way instant conversation. Ideal as Baby Alarm and Door Phone. Complete with 66 ft. connecting wire. Battery **2/6.** P. & P. 3/6.

7-STATION INTERCOM

(1 MASTER & 6 SUB-STATIONS) in strong metal cabinets. Fully transistorised. 3½in. Speakers. Call on Master identified by tone and Pilot lamp. Ideally suitable for Office, Hotel, Hospital and Factory. Complete with 50 yards cable and batteries. Price **18 gns.** P. & P. 12/6 in U.K.

WW—172 FOR FURTHER DETAILS

Transistor TELEPHONE AMPLIFIER

Usually 6 Gns. OUR PRICE ONLY 55/-

Why not increase efficiency of Office, Shop and Warehouse with this incredible De-Luxe Portable Transistor **TELEPHONE AMPLIFIER** which enables you to take down long telephone messages or converse without holding the handset. A useful office aid. A must for every telephone user. On/off switch. Volume Control. Operates on one 9 v. battery which lasts for months. Ready to operate. P. & P. 2/6 in U.K. Add 2/6 for Battery. Full price refunded if returned in 7 days.

WEST LONDON DIRECT SUPPLIES (W.W.),
169 Kensington High Street, London, W.8

INDEX TO ADVERTISERS

Appointments Vacant Advertisements appear on pages 113-125

	PAGE
Acoustical Mfg. Co., Ltd.	43
Adcola Products, Ltd.	Cover iii, 60
A.D.S. Relays, Ltd.	34
Advance Electronics, Ltd.	54, 63
Akurate Eng. Co., Ltd.	126
Anders Electronics, Ltd.	2, 30, 42
Andrew Antennas	47
Antiference, Ltd.	4
A.N.T.E.X., Ltd.	12
A.P.T. Electronics, Ltd.	58
Armstrong Audio, Ltd.	74
Ash Electronics, Ltd.	50
Audix, B. B., Ltd.	78
Avo, Ltd.	1
Avon Communications & Electronics	100
B. & K. Laboratories, Ltd.	48
Batey, W., & Co.	84
Belling & Lee, Ltd.	56
Bentley Acoustic Corpn., Ltd.	86
Bi-Pak Semiconductors	130
Bi-Pre-Pak	96
Bird, S. S.	32
Black, J.	129, 130
Bradley, G. & E., Ltd.	79
Britain, Chas. (Radio), Ltd.	88
British Institute of Engineering Technology	13
Broadfields	129
Brown, N. C., Ltd.	44
Brush Clevite, Ltd.	21
B.S. Radio & Electrical Store	112
B.S.R., Ltd.	32, 33
Bulgin, A. F., & Co., Ltd.	Edit. 461
Bullers, Ltd.	42
'C' Aerials	126
Cannon Electric, Ltd.	78
Carr Fastener Co., Ltd.	48
Chiltmead	104
Codar Radio	20
Coubro & Scrutton, Ltd.	72
C.R.E.I. (London)	51, 52
Crosswire Electronics	128, 129
Cursons, B. W.	131
Cybernaut Controls	44
Daystrom, Ltd.	8, 9, 10, 11, 130
Deimos, Ltd.	130
Drake Transformers, Ltd.	17
Electrical Engineering Association	67
Electrolube, Ltd.	84
Electronics (Croydon), Ltd.	99
Electrosil, Ltd.	46
Electrovalue	131
Electro-Winds, Ltd.	34
Elliott Insts., Ltd.	60
E.M.I. Sound	86
English Electric Valve Co., Ltd.	3, 5, 7
Erie Resistor, Ltd.	45
Experimental Electronics	103
Ferranti, Ltd.	57
Ferrograph, Ltd.	36
Finnigan Speciality Paints, Ltd.	130
Foamair, Ltd.	82
Gardners Transformers, Ltd.	70
Gee Bros. (Radio), Ltd.	96
General Post Office	39
Genevac, Ltd.	38
Gladstone Radio	98
Glaser, L., & Co., Ltd.	128
Goldring Mfg. Co., Ltd.	55
Goodmans Industries, Ltd.	16
Grampian Reproducers, Ltd.	130
Hall Electric, Ltd.	62
Hall, G. D.	130
Harmsworth, Townley & Co.	59
Harris Electronics (London), Ltd.	26
Harris, P.	127
Hart Electronics	126
Harversons Surplus Co., Ltd.	100
Harwin Engineers, Ltd.	47
Hatfield Instruments, Ltd.	80
Hellerman Electric, Ltd.	68
Hengstler, J., Ltd.	85
Henry's (Radio), Ltd.	102, 103
Horntons Electronics	87
Household Electrix, Ltd.	81
Howells Radio, Ltd.	28
H.P. Radio Services, Ltd.	26
Iliffe Books, Ltd.	106
I.M.O. (Electronics), Ltd.	89
Industrial Instruments, Ltd.	40
Instructional Handbook Supplies	131
International Correspondence Schools	36, 87, 130
John's Radio	126
Keyswitch Relays, Ltd.	83
Kingswood Supplies	128
Kolectric, Ltd.	82
Labgear, Ltd.	24
Lasky's Radio, Ltd.	92, 93
Lawson Tubes	127
Leak. H. J., & Co., Ltd.	73
Ledon Instruments, Ltd.	87
Levell Electronics, Ltd.	29
Lewis Radio Co.	112
Lexor Electronics, Ltd.	32
Light Soldering Developments, Ltd.	30
Lind-Air Electronics, Ltd.	26
Linear Products, Ltd.	38
Lionmount & Co., Ltd.	128
London Central Radio Stores	131
London Microphone Co.	50
Londtra, Ltd.	81
Lustraphone, Ltd.	83
Lyons, Claude, Ltd.	61
Marconi Company, Ltd.	69
Marriott Magnetics, Ltd.	27
Marshall, A., & Son (London), Ltd.	131
Mills, W.	104, 105
Modern Book Co.	103
Morganite, Ltd.	25
M.R. Supplies, Ltd.	22
Mullard, Ltd.	66
Multicore Solders, Ltd.	Cover iv
Naylor, G.	131
Nombrex, Ltd.	50
Omron, Ltd.	19
Osmabet, Ltd.	104, 130
Partridge Transformers, Ltd.	42
Pattrick & Kinnie	95
P.C. Radio, Ltd.	106, 107
Peerless	14
Pembridge College	24
Pinnacle Electronics, Ltd.	15
Post Radio Supplies	129
Pye Telecommunications, Ltd.	31
"Q-Max" (Electronics), Ltd.	83
Quartz Crystal Co., Ltd.	127
Raaco, Ltd.	81
Racal Instruments, Ltd.	53
Radford Electronics, Ltd.	85
Radio & T.V. Components (Acton), Ltd.	97
Radio & T.V. Services, Ltd.	41, 84
Radio Component Specialists	131
Radio Exchange Co., The	87
Radiospares, Ltd.	126
R. & R. Radio	128
Rastra Electronics, Ltd.	34
Readers Radio	98
Rock & Taylor, Ltd.	126
Rola Celestion, Ltd.	22, 23
R.S.C. Hi-Fi Centres, Ltd.	94, 95
Salford Elec. Inst. Co., Ltd.	37
Sallis, A. T.	128
Samsons (Electronics), Ltd.	101
Savage Transformers, Ltd.	23
Scientific Products	129
Service Trading Co.	90, 91
Servo & Electronic Sales, Ltd.	130
Silentbloc, Ltd.	6
Sinclair Radionics, Ltd.	75, 76, 77
S.M.E., Ltd.	20
Smith, G. W., (Radio), Ltd.	108, 109
Smith, H. L., Co., Ltd.	33
Smith, John, Ltd.	40
Special Product Distributors	60
Standard Telephones & Cables, Ltd.	Cover ii
Starman Tapes	127
Sutton Electronics	103
Technical Trading Co.	101
Tektronix U.K., Ltd.	18
Telequipment, Ltd.	64
Telford, Ltd.	112
Teonex, Ltd.	32
Thompson, A. J.	125
Thorn Special Products, Ltd.	35
Trio Corporation	49
T.R.S. Radio	100
United-Carr Supplies, Ltd.	28
Universal Book Co.	129
Valradio, Ltd.	28, 34
Velco	131
Vitality Bulbs, Ltd.	22, 44
Vortexion, Ltd.	71
Watts, Cecil E., Ltd.	128
Webber, R. A., Ltd.	50
Welbrook Eng. & Elec., Ltd.	98
West Hyde Developments, Ltd.	130
West London Direct Supplies	132
Whiteley Elec. Radio Co., Ltd.	40, 44
Wilkinson, Ltd., (Croydon), Ltd.	90
Wingrove & Rogers, Ltd.	78
Yukan	129
Z. & I. Aero Services, Ltd.	110, 111, 131

Printed in Great Britain for the Publishers, ILIFFE TECHNICAL PUBLICATIONS LTD., Dorset House, Stamford St., London, S.E.1, by CORNWALL PRESS, Paris Garden, London, S.E.1. *Wireless World* can be obtained abroad from the following: AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; William Dawson & Sons (S.A.) Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street, New York 14.

ADCOLA
(PRODUCTS LIMITED)
(Regd Trade Mark)
SOLDERING EQUIPMENT

SPECIALIST MANUFACTURERS OF THE MOST MODERN UP-TO-DATE SOLDERING EQUIPMENT IN THE WORLD

OVER A DOZEN DIFFERENT MODELS OF SOLDERING INSTRUMENTS AVAILABLE, WITH A CHOICE OF 54 DIFFERENT BITS RANGING IN SIZE FROM $\frac{1}{32}$" TO $\frac{3}{4}$", IN TEMPERATURES OF 250°C TO 500°C TO SUIT ANY VOLTAGE SUPPLY, AND WITH LONG LIFE BITS IF REQUIRED.

SPECIAL SOLDERING INSTRUMENT BITS MANUFACTURED TO CUSTOMERS' REQUIREMENTS.

FULL AFTER SALES SERVICE, INCLUDING TECHNICAL ADVICE, AVAILABLE ON ALL EQUIPMENT.

HAND PYROMETERS, HAND & BENCH THERMAL CABLE STRIPPERS, TRANSFORMERS, BENCH MOUNTED SOLDERING INSTRUMENTS, AN ANTI-SEIZING COMPOUND FOR SOLDERING INSTRUMENT BITS, PROTECTIVE SHIELDS, ARE ALL PART OF THE ADCOLA RANGE OF HIGH EFFICIENCY SOLDERING EQUIPMENT.

Send for details to

HEAD OFFICE SALES & SERVICE

ADCOLA PRODUCTS LTD

ADCOLA HOUSE, GAUDEN ROAD,

LONDON, S.W.4.

Telephones: 01-622-0291/3 *Telegrams: SOLJOINT, LONDON, S.W.4*

AUSTRALIAN ASSOCIATES: ADCOLA PRODUCTS PTY. LTD., 673 WHITEHORSE ROAD, MONT ALBERT, MELBOURNE
AGENTS IN ALL LEADING COUNTRIES

for repetition soldering processes use precision made solder pellets

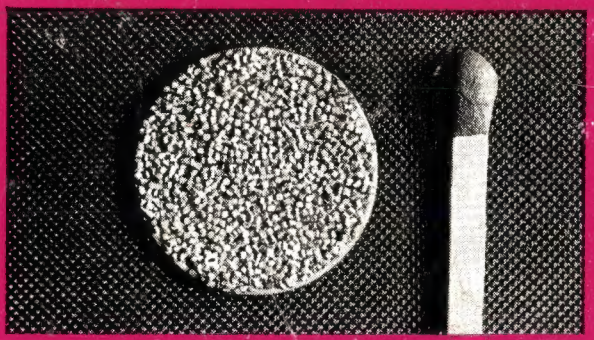
ERSIN Multicore 5 CORE SOLDER

Precision made solder pellets should reduce materially the cost of automatic soldering processes where a very small precise weight of solder is required for each joint. Previously preforms of solder by the use of discs or spheres have often been employed for this purpose which have also proved comparatively expensive to make owing to accumulation of scrap during production.

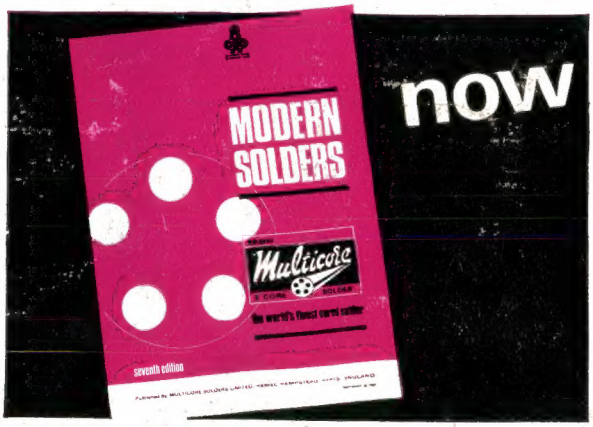
After a considerable amount of research it has now been made possible to manufacture cylindrical pellets which can be cut to an accuracy of ·001" from drawn wire which eliminates the production of any scrap.

These Multicore pellets are now available in tin/lead alloys to British and U.S.A. Specifications. The pellets can be supplied either without flux or containing up to 5 cores of non-corrosive Ersin flux. Virtually any combination of length and diameter pellet is available, also pieces of solder tape square or rectangular in shape.

Please contact us for free advice, samples and literature if you think you have a use for Solder Pellets, tape, rings or any other solder application.



The illustration above shows 1000 Pellets. Diameter ·022" with a length of ·024", laid over a 6d. The match head serves to illustrate the comparison in size.



now available!

7th edition of Modern Solders

Engineers and technicians are invited to write on their Company's letterheading for the new comprehensive A4 size 7th edition of Modern Solders containing complete information on the full range of Ersin Multicore Solders, Printed Circuit Materials, Solderability Test Machine and Automatic Soldering Equipment.

Multicore Solders Ltd

Hemel Hempstead, Herts.
Telephone: Hemel Hempstead 3636 Tele

WW—002 FOR FURTHER DETAILS